NATIONAL FOREST MONITORING
FOR REDD+ IN SUDAN

Manual for integrated field data collection

Food and Agriculture Organization of the United Nations

FOREST CARBON PARTNERSHIP FACILITY

WORLD BANK GROUP

REDD+

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Manual for integrated field data collection

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Abbreviations and Acronyms

cc	Canopy cover
CSP	Circular subplot
Dbh	Diameter at breast height
Dsh	Diameter at stump height
FAO	Food and Agricultural Organization of the United Nations
FDT	Fallen deadwood transect
FRA	Global Forest Resources Assessment programme
GPS	Global Positioning System
HS	Number of households
LSP	Litter subplot
LUCC	Land use/cover class
LUCS	Land use/cover section
MDGs	Millennium Development Goals
NFMA	National Forest Monitoring and Assessment
NFI	National Forest Inventory
NGO	Non Governmental Organization
NPC	National Project Coordinator
NSC	National Steering Committee
NWFP	Non wood forest product
OWL	Other wooded lands
P/S	Products and services
PTU	Project Technical Unit
RSP	Rectangular subplot
RRA	Rapid rural appraisal
scf	Slope correction factor
SI	Sampling interval
SN	Starting number
SU	Sampling unit
TOF	Tree outside forest
UTM	Universal Transverse Mercator

Introduction

This manual provides guidelines and descriptions of the field data collection methodology and procedures used to inventory and monitor forestry and other land use resources following the approach developed by the Support to National Forest Resources Monitoring and Assessment (NFMA) programme of the FAO. The methodology, based on countrywide sampling and field data collection as well as on remote sensing, has been applied since 2000 in several countries through national forest inventories, including Angola, Bangladesh, Brazil, Cameroon, Comoros, Congo, Costa Rica, Gambia, Guatemala, Honduras, Kenya, Kyrgyzstan, Lebanon, Nicaragua, the Philippines, Zambia, Uruguay and Ethiopia. A NFMA typically covers not only forest resources or forest lands but also trees outside forests.

In 2005, the methodology was broadened to cover other land uses and natural resources in the assessment such as crops, livestock, soils, water and biodiversity features. Integrating the assessment and monitoring across forest, agriculture and other related sectors, offers a better understanding of ecosystem services and functions and creates possibilities for analysing land management as a whole. For example, conflicting objectives between sectors – such as subsidies to agriculture vs. efforts to reduce deforestation, may be analytically weighed against each other. This approach was applied to implement Integrated Land Use Assessments (ILUA) in Zambia and Kenya, and can be profitable when the country promotes intersectoral collaboration and when there is need for information on natural resources to be generated in an integrated manner.

The purpose of a NFMA is to assess and monitor forest and other natural resources, land uses and management practices, in order to provide new qualitative and quantitative information on the state, use, management and trends of these resources and the ecosystems. The assessment covers a wide range of biophysical and socio-economic variables, and thus provides a holistic view of land use and its impacts for the country as a whole. In particular, the information can be used to plan, design and implement national and international policies and strategies for sustainable use and conservation of natural ecosystems, and to understand the relationship between resources and users of resources. Periodic monitoring (such as every 5 years) will enable the development of more harmonised policies to ensure sustainable land management and its contributions to biodiversity conservation, and improved food security and livelihoods of rural populations. NFMA will thus help in monitoring progress towards the Millennium Development Goals (MDGs) especially in regard to food security, poverty alleviation and the environment (MDGs 1 and 7).

The field manual is addressed to field data collectors as well as to national forest inventory planners, trainers and field inventory supervisors. The methods, assessment variables and tools presented in this field manual template are not rigid. They have to be tailored and adapted to each individual country, taking into account national contexts, social and ecological environments, and information requirements at the national level. Involvement of all stakeholders is essential in this adaptation process to ensure that results will meet expectations of all national level information users. Some core variables to be assessed, definitions and options are selected in accordance to international standards, in order to facilitate country reporting to various international processes and encourage harmonisation between data collection initiatives among countries. However, most of the variables, their

definitions and options as well as field forms (data collection record sheets) can (and need to) be modified according to country specifications.

As more information is required in an ILUA compared to a NFMA, additional data collection tools and methods were introduced but the overall approach and basic principles remain the same. In particular, more emphasis is placed on collecting a wide range of socio-economic data. Moreover, some groups of variables and corresponding field forms can be considered as modules that can be retained or excluded depending on information needs (for instance, water management, wildlife observations).

The first part of the manual describes the adopted sampling design, distribution of the sampling units where measurements are carried out and their configuration. Part two deals with the Land Use/Cover classification adopted as a basis for the assessment. Part three presents organisational structure and responsibilities of field team members. Methods and procedures for data collection in the field are described in part four, while part five presents in detail the field forms that are used for recording data from field measurements, observations and interviews with forest and land users.

The Annexes provide practical tools and methods for measuring the variables (tree and soil measurements), a guide for the use of Global Positioning System (GPS) receivers and techniques and approaches to carry out guided discussions and interviews with key informants and resource user groups.

1. Sampling design

1.1 Sampling unit selection

The sampling design adopted for the NFMA is systematic. Sampling units (SU) are selected at least at the intersection of every degree of the latitude/longitude grid.

Depending on country's situations and information needs, higher sampling intensity may be applied. Stratification may be adopted in situations where stable strata such as ecological zones are deemed to improve the design.

The number of sampling units (SU) or tracts to be surveyed is determined by the required statistical reliability of the data, the available financial and human resources for the assessment, and with a view to enabling periodic monitoring. The example of the sampling design applied in a few countries is shown in Table and Figure 1.

Table 1. Sampling density in several countries

Country	Stratum	Sampling unit (tract) number	Distance between sampling units	
			minutes (latitude x longitude)	km (latitude x longitude)
Lebanon	No stratification	226	4' x 4'	about 7 x 6 km
Philippines	No stratification	389	15'x 15'	about 25x 25km
Cameroon	1	167	30' x 15'	about 50 x 25 km
	2	69	30' x 30'	about 50 x 50 km
	TOTAL	236		
Guatemala	1	28	15 ' x 30 '	about 28 x 54 km
	2	71	15 ' x 15 '	about 28 x 28 km

Figure 1. Distribution of Sampling Units (or Tracts) in several countries
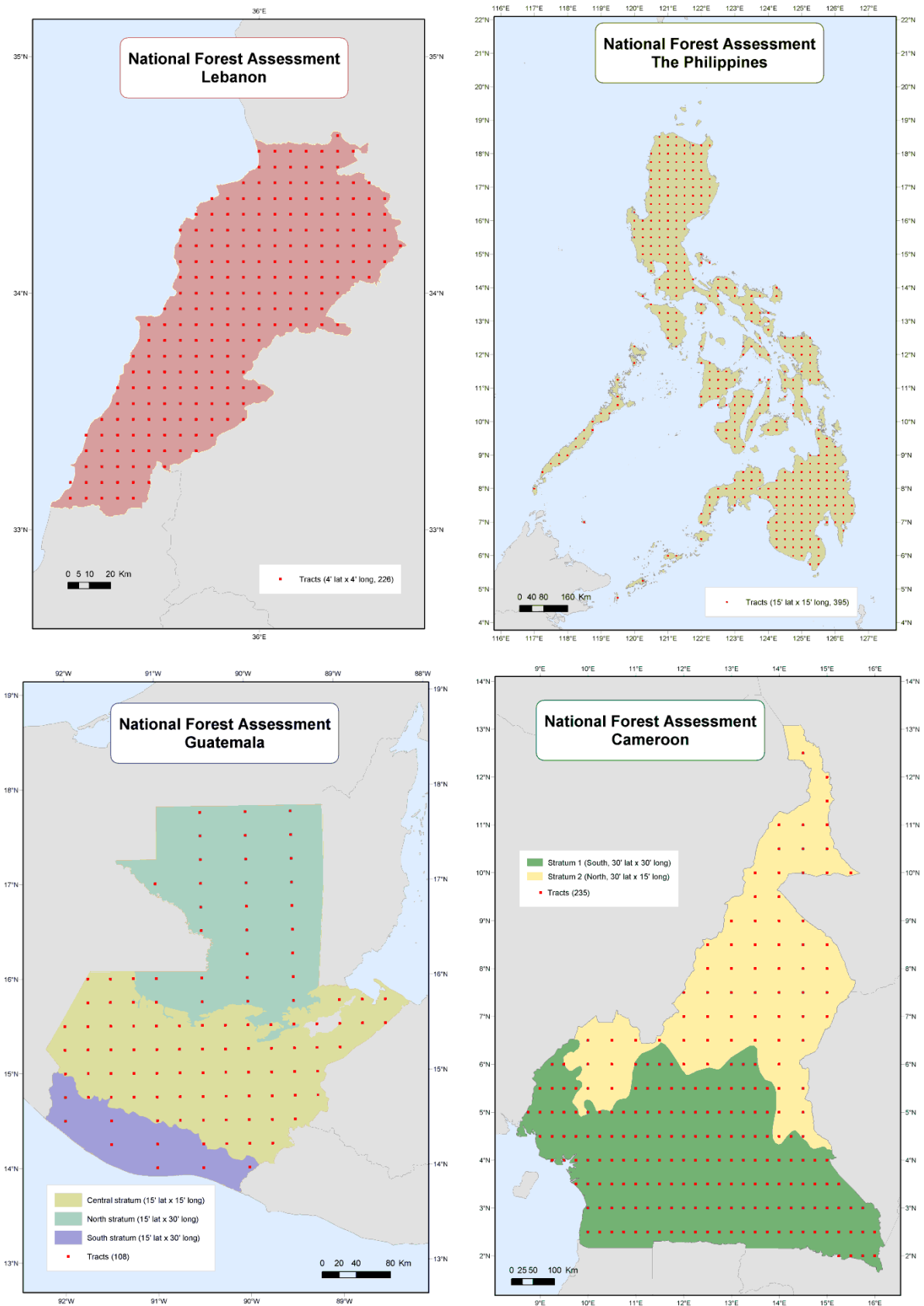
1.2 Sampling unit description

Data is collected in the field through observations, measurements and interviews at different levels: within the limits of the sampling units (SU) and in smaller subunits, the plots, subplots, Land Use/Cover Sections (LUCS) and Land Use/Cover Classes (LUCC) demarcated within the sampling units (see Figure 2).

- A **sampling unit (SU)** or "Tract" is a square surface area of 1 km x 1 km (see Figure 2). The coordinates of the south-west corner of the SUs correspond to those of the points selected in the systematic sampling frame. Each SU contains four field plots.

- The **plots** are rectangles, with surface areas measuring 20 m wide and 250 m long within the SU. They start at each corner of an inner 500 m square (same centre as SU's), and are numbered clockwise from 1 to 4 as shown in figure 2. The location and orientation of the 4 plots are given in Table 2

Table 2. Plot location and orientation

Plot	Location of the starting point of the plot, within the 500 m inner square	Orientation	Bearing
Plot 1	South-West corner	South-North	0 / 360 degrees
Plot 2	North-West corner	West-East	90 degrees
Plot 3	North-East corner	North-South	180 degrees
Plot 4	South-East corner	East-West	270 degrees

- Three sets of **subplots** are delimited within each plot. They correspond to different data collection levels:

    o 3 **Rectangular Subplots (RSP)**, 20 m x 10 m (200 m^2), corresponding to level 1;

    o 3 **Circular Subplots (CSP)**, with a radius of 3.99 m (50 m^2), corresponding to level 2, located in the left-hand half of the rectangular subplots; and

    o 3 **Litter Subplots (LSP),** also circular but smaller with a radius of 18 cm (about 0.1 m^2), corresponding to level 3, located in the centre of the Circular Subplots.

All these subplot categories are numbered from "1" to "3", from the starting point of the plot to the end of the plot.

- An edaphic (soil) and topographic **measurement point (MP)** is established at the centre of each rectangular subplot.

- A **fallen deadwood transect** line (FDT) is located at the end of each rectangular subplot.

Figure 2. Sampling unit, plot and subplot design
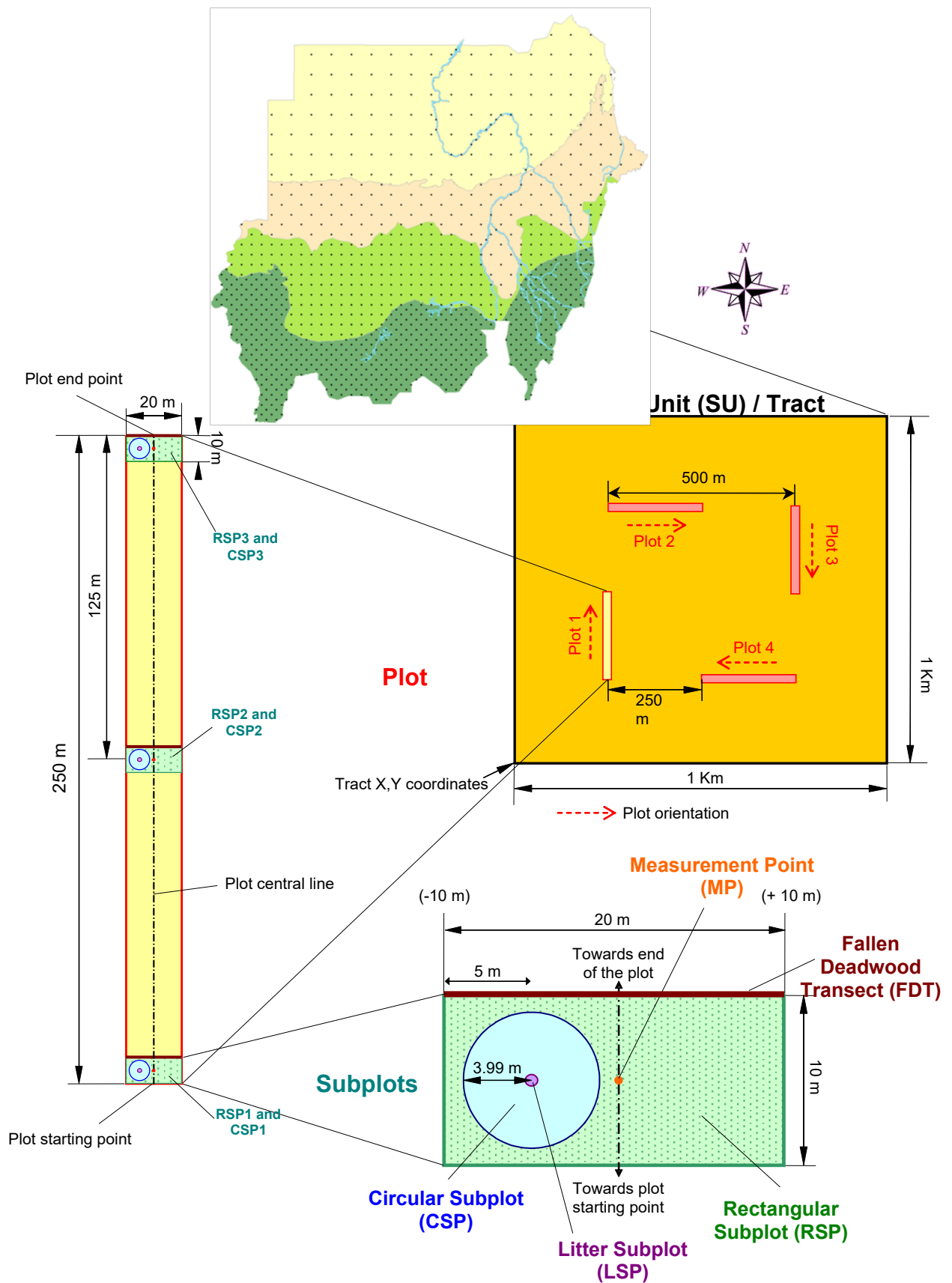
- Each plot is divided into **Land Use/Cover Sections (LUCS)** representing homogenous land use / vegetation cover units (forest, crops, grassland...), with variable size and shape that have been identified in the field. The classification system adopted to identify the different land use/cover classes is described in chapter 2. Data related to grazing, cropping and forest characteristics, management and resources use and users are collected within the LUCS.

Figure 3. Example of Land Use/Cover Sections (LUCS) distribution within a plot

Note: There are four land use/cover (LUCS) sections in this plot. The wavy lines indicate the limits between them. LUCS2 and LUCS4 belong to the same Land Use/Cover Class (LUCC).

- All **Land Use/Cover Class (LUCC)** found in all 4 plots in the SU will also be used to collect data on products and services (

- Figure 4). If a land use/ cover class is identified in the SU but is not represented inside the plots, it is not considered.

Figure 4. Example of Land Use/Cover Classes (LUCC) distribution within a sampling unit
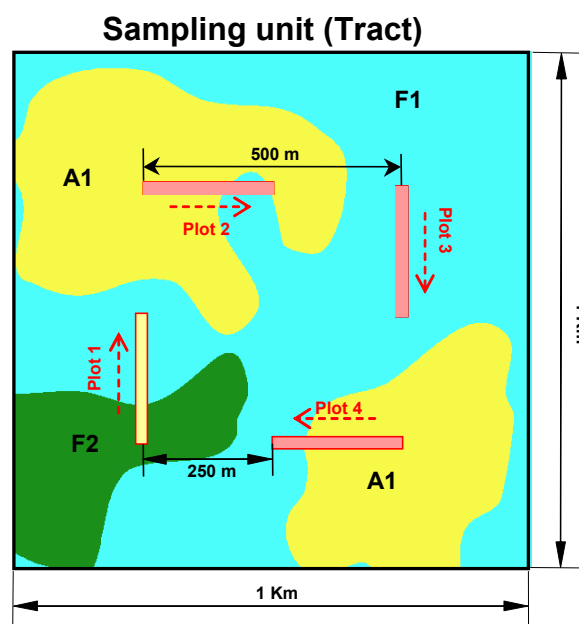
Note: In this example there are three different land use/cover classes in the sampling unit (coded A1, F1 and F2).

Table 3. Survey unit specifications

Unit	Shape	Size (area)	Number
Sampling Unit (SU) (or Tract)	Square	1000 m x 1000 m (1km^2)	1
Plot	Rectangle	250 m x 20 m (5000 m^2)	4/SU
Rectangular Subplot (RSP)	Rectangle	20 m x 10 m (200 m^2)	3/plot
Circular Subplot (CSP)	Circular	Radius r = 3.99 m (50 m^2)	3/plot
Litter Subplot (LSP)	Circular	Radius r = 18 cm (0.1 m^2)	3/plot
Fallen Deadwood Transect (FDT)	Line	20 m	3/plot
Land Use/Cover Sections (LUCS)	Variable	Variable	Variable
Land Use/Cover Class (LUCC)	Variable	Variable	Variable

Note: All distances indicated are horizontal distances.

2. Land use/cover classification

The classification system used to define land use/cover classes (LUCC) is based on a dichotomous approach and includes different levels:

- **The first level** is composed of the global classes designed for the assessment of resources at global level and is based on the classification system developed by the FAO global Forest Resources Assessment (FRA) to ensure harmonisation between countries for regional or global assessments. The global classes include **Forests, Other wooded land**, **Other land** and **Inland water**;

- **The other levels** are country specific, and include additional classes designed to meet specific national and sub-national information needs. They can be applied to differentiate between land use/cover categories according to criteria such as species composition, phenology, vegetation canopy cover (closed/ open/ sparse), naturalness (primary/ secondary forest).

A code characters is assigned to each class in order to facilitate data collection and input.

An example of the classes and related codes used in NFMA is shown in **Erreur ! Source du renvoi introuvable.**. The diagram in Figure shows the dichotomous approach and the class subdivision. Global classes are further defined in Annex (section 6.1).

Table 4: Land use /cover classification in the NFA of SUDAN

Level 1	Level 2	Level 3	Brief description	Code
Forest		<u>FNC Definition:</u> Forest means land bearing a vegetative association and spanning more than 0.5 ha (or 0.42 ha =an equivalent of a Sudanese feddan) with trees at least 2m high and a minimum tree canopy cover of 10%; or young forests stands that have not yet reach, but are expected to attain these thresholds in situ. It does not include land that is predominantly under agricultural and/or agro-forestry production systems or urban land use.		F
	Natural regenerated forest	*Forest predominantly composed of trees established through natural regeneration.*		
		Evergreen forest	Naturally regenerated forest composed of more than 75% of evergreen trees species. Includes : • Moist forest • Dry forest	FE
		Deciduous forest	Naturally regenerated forest composed of more than 75% of deciduous trees species. Includes : • Moist forest • Dry forest • Secondary young	FD
		Semi-deciduous forest	Naturally regenerated forest where trees are at least 25% each of evergreen and deciduous species. Includes : • Moist forest • Dry forest • Secondary young	FSD
		Bamboo forest	Naturally regenerated forest predominantly composed of bamboo vegetation.	FB
		Raffia/Palms	Naturally regenerated forest predominantly composed of palm or raffia vegetation.	FRP
	Plantation	*Forest predominantly composed of trees established through planting and/or deliberate seeding. Includes coppice from trees that were originally planted or seeded.*		
		Broadleaved planted forest	Planted forest composed of more than 75% of broadleaved species. Includes: • Eucalyptus sp. • Acacia sp. • Gravillia	FPB
		Coniferous planted forest	Planted forest composed of more than 75% of coniferous species. Includes :	FPC

			• Cupressus lusita. • Juniperus • Pinus patula	
		Mixed planted Forest	*Planted forest of at least 25% each of coniferous and broadleaved species.*	**FPM**
	Area ≥ 0.5 ha, tree crown cover 5- 10% or shrubs/bushes canopy cover ≥10%			**W**
Other wooded lands	**Woodland**		Includes : • Acacia comiphora • Combretum terminalia • Others (bushes,..)	**W**
	Wooded grassland		*Land covered by natural growth of graminea and herbaceous vegetation, with some scattered trees (tree canopy cover between 5-10%); Land not covered seasonally or permanently by water.* Includes: • Acacia sp. • Others (Combretum sp...)*	**WG**
	Wooded wetland		*Land seasonally or permanently covered by water with natural growth of graminea and herbaceous vegetation and some scattered trees (canopy cover between 5-10%).*	**WW**
Other Land	***Land not classified as forest or other wooded land, as described above (Includes land with tree canopy cover <5% or with shrubs/bushes <10% or with predominant agricultural/urban land use or with shrubs/ trees<0.5ha).***			**O**
	Natural	**Barren Land**	*Land where vegetation cover is less than 2%. Includes land covered of sand, soil and rocks.*	**OX**
		Natural Grassland	*Land covered with natural growth of graminea and herbaceous vegetation.*	**OG**
		Marsh	*Land seasonally or permanently covered by water and dominated by natural growth of graminea, reed and other herbaceous.*	**OM**
	Cultivated	**Improved pastures**	*Land sown with introduced grass and leguminous for the grazing of livestock.*	**OP**
		Annual Crop	*Area covered by crops that are sown and harvested during the same production season/ agricultural year.*	**OCA**
		Perennial crop	*Crops that are sown or planted once and need not to be replanted after each annual harvest. Includes trees (e.g. apples or other fruit trees), bushes and shrubs (e.g. berries, coffee...), palms (e.g. dates), vines (e.g., grapes), herbaceous stems (e.g. bananas) and stemless plants (e.g. pineapples).*	**OCP**
		Mixed annual and perennial crop	*Association of annual and perennial crops.*	**OCM**
		Fallow	*Previously cultivated land kept free from crops or weeds during at least one*	**OF**

			growing season, where woody vegetation is and will not reach 5m height.	
		Wood lot of Bamboo	*Bamboo areas spanning between 0.2 and 0.5 ha , with trees >5m at maturity mainly used is for wood stock*	**OWB**
		Wood lot	*Other areas spanning between 0.2 and 0.5 ha , with trees >5m at maturity mainly used is for wood stock*	**OW**
	Built up area		*Populated areas with significant constructions. Includes homes scattered in the field.* *Notes: a road is considered as a distinct Land Use/Cover Section (built-up area) if wider than 15 meters (from bottom of ditch on one side to the bottom of ditch on the other side when ditches exists, otherwise the width of the road bank) and if not a forest road.*	**OB**
	Quarry/Mining site		*Areas used for extraction of minerals, rocks, sands, clay... Includes: quarry, mining, extraction areas, oil/gas wells.*	**OQ**
Inland water	*Area occupied by major rivers (width ≥ 15m), lakes, ponds and reservoirs.*			**IW**
	Perennial River		*Rivers (width ≥ 15m) that maintains water in its channel throughout the year.*	**IRP**
	Intermittent River (seasonal)		*Rivers (width≥ 15m) that flows only at certain times of the year.*	**IRS**
	Lake		*Large body of salt or fresh water surrounded by land.*	**IL**
	Dam		*Reservoir created by a barrier constructed to hold back the water and raise its level.*	**ID**
	Pond		*Small body of still water formed naturally or by hollowing or embankment.*	**IP**

Figure 5. Example of Land Use/Cover classification for the NFMA in Sudan

Total country area
- Forest
  - Naturally regenerated forest
    - Evergreen
      - Primary
      - Secondary
      - Secondary
    - Deciduous
      - Primary
      - Secondary
      - Secondary
    - Semi-deciduous
      - Primary
      - Secondary
      - Secondary
    - Bamboo forest
    - Raffia/ Palms
  - Planted forest
    - Broadleaved
    - Coniferous
    - Mixed planted forest
- Other wooded land
  - Shrubs/ Woodlan
  - Wooded grasslands
  - Wooded wetland
- Other land
  - Natural
    - Barren land
    - Natural grassland
    - Marsh
  - Cultivated
    - Improved pastures
    - Annual crop
    - Perennial crop
    - Mixed annual/ perennial crops
    - Fallow
    - Wood lot
  - Built-up area
  - Quarry / Mining site
- Inland water
  - Perennial river
  - Intermit-tent river
  - Lake
  - Dam
  - Pond

Global classes

National classes

3. Organisational structure and responsibilities

3.1 Organisational chart

The organisation structure of NFMA in Sudan is set up at the Ministry of Agriculture and Forestry. The Forests National Cooperation (FNC) is designated as Focal Institution. The project is led by a full time National Project Coordinator (NPC). A Project Implementation Team (PIT) whose members are drawn from participating National Institutions is created to coordinate, execute and monitor the project activities. The PIT is supervised by the FAO Project Task Force and the National Steering Committee (SC) whose mandate is be to oversee the NFMA activities. Field teams work in collaboration with the PIT and are responsible to undertake field data collection. One or several quality control teams will be verifying in the field some of the sampling units, randomly selected for each field team, in order assess the quality of the work carried out by the field teams.

Figure 6. Organisation chart for the NFMA
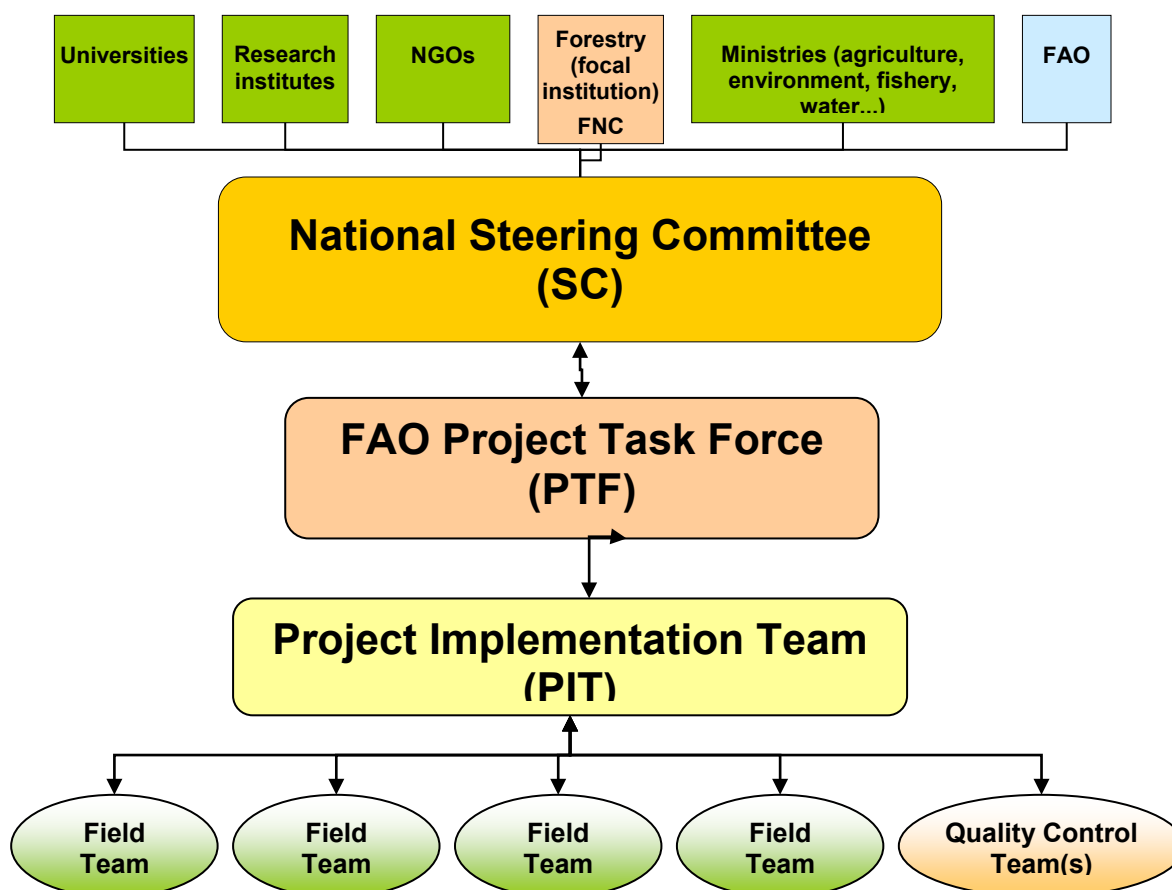
The **Project Implementation Team (PIT),** for day-to-day execution of the Project, a joint PIT will be created, composed of Government of Sudan staff and FAO staff. The PIT shall be led by the National Project Coordinator (NPC) assigned by Government of Sudan. The National

Project Coordinator and the FAO Project Coordinator will work closely to plan, implement and coordinate activities with the REDD+ National Focal Point. The composition of the PIT will evolve as the Project progress and will also include national and international consultants hired for specific tasks (both short term and long term assignments). This is done through:

- Analysis and adaptation, if needed, of NFMA sampling design, inventoried variables and definitions;
- Conducting training and hands-on training for Field Teams;
- Setting up the Field Teams;
- Mobilisation of resources, and preparation of necessary resources and equipment such as vehicles, allocation of sampling units (SUs) among field teams; ensuring that all project requirements are procured timely for the project to be executed smoothly;
- Planning, organisation and coordination of fieldwork among districts and field teams;
- Monitoring and backstopping fieldwork, including technical and logistic support to field teams as well as field report checks, in order to ensure data quality and homogeneity among field teams;
- Control and validation of field forms;
- Data control and quality evaluation;
- Compilation of databases;
- Data processing and analysis;
- Report progressed to National Steering Committee; and
- Reporting and dissemination of results.

The **Project Implementation Team** should ensure that there are mechanisms for effective participation of all key institutions that have direct valuable input in NFMA design and implementation. The PIT should also develop collaboration with relevant national projects involved in assessment and monitoring to enhance networking, coordination and use of findings.

The **Field Teams** are responsible for collection and recording of data in the field and transmission of the field forms to the Project technical Unit. Whenever it is possible, they are also responsible for data entry.

3.2 Field team composition

The composition of a NFMA field team may be from four to eight members, taking into account the amount of information to be collected on the various land uses and the division of tasks among individuals. One or two members of the field teams (temporary assistants) are hired locally and act as guides in the field.

The team should include at least one person specialized in each of the concerned key disciplines, depending on the type of information to be collected in the assessment: forestry, range, botanic, sociology, wildlife, crop, livestock, soil, fishery, water, etc.

Moreover, at least one of team members who will be more working on field measurements

and observations should also have some skills in interviewing, to carry out interviews with key informants as well as with focus groups and individuals. As some interviews (in particular focus group interviews) often have to be gender separated, it is recommendable that one of the team members assigned to interview activities is female.

In addition the inclusion of a student in an appropriate discipline (forestry, range, agriculture, environment, ecology) is strongly recommended for capacity building. Additional persons may be included to improve performance of the field teams when conditions require greater resources.

In general team members must be experienced in tree, shrub and herbaceous species identification (using local and/or scientific names). It is also recommended that some of the team members speak the local language.

The responsibilities of each team member must be clearly defined and their tasks are proposed as follows:

- The **team leader** is responsible for organizing all the phases of the fieldwork, from the preparation to the data collection. He/she has the responsibility of contacting and maintaining good relationships with the community and the informants and monitoring and ensuring timely progress in the fieldwork. He/she will specifically:

  - ✓ Prepare the fieldwork: carry out the bibliographic research and gather required secondary data, field forms and maps at appropriate scales;
  - ✓ Plan the work for the team;
  - ✓ Establish contact and introduce the survey objectives and work plan to local authorities, local technical officers (forestry, agriculture, land, community development), and request their assistance to inform local communities and identify key informants, guides and assistants;
  - ✓ Administer the location and access of SUs and plots;
  - ✓ Take care of team logistics: obtain information and organise accommodation facilities and food (meals; cooking facilities); recruit local assistants; organize access to the SUs;
  - ✓ Plan /organise the interviews together with those team members assigned to undertake interviews;
  - ✓ Be responsible for ensuring accurate filling in of recording forms and taking notes and applying cross-checking procedures to insure reliable data;
  - ✓ Organize daily meetings after fieldwork in order to sum up the day's activities and plan the next day;
  - ✓ Make a report of the SU summarizing the data collection process;
  - ✓ Take necessary measurements and observations and carry out interviews;
  - ✓ Enter the data in the database (if possible);
  - ✓ Organize and ensure fieldwork safety (first aid kit, support of local authority/armed guards if required, reduce risk from wildlife);
  - ✓ Maintain good team spirit.

- The **assistant of the team leader** will:

  - ✓ Help the team leader to carry out his/her tasks;

- ✓ Ensure easy access to the SU with a guide very familiar with the area;
- ✓ Take necessary measurements and observations and carry out interviews;
- ✓ Make sure that the equipment of the team is always complete and operational;
- ✓ Supervise and orient the temporary assistants;
- ✓ Assist the team leader in the making of the SU report;
- ✓ Take over if the team leader falls sick.

- **The technical field team members/enumerators** will carry out the field measurements and interviews.

- **The temporary assistants, who are recruited locally, should be** assigned the following tasks, according to their skills and knowledge of local species, language and practices:
  - ✓ Help to measure distances;
  - ✓ Provide the common/local name of tree, plants, and wildlife species;
  - ✓ Inform about access to the SU;
  - ✓ Open ways to facilitate access and visibility to technicians;
  - ✓ Provide information about the various natural resources uses and management (forest, soil, water, crop, livestock...);
  - ✓ Carry the equipment.

Training of the teams on the survey methodology should be undertaken in theoretical and practical sessions in the beginning of the fieldwork where techniques of different land measurements, tally of data and techniques of interviews will be explained and practised.

The names and addresses of the team members must be written down in field **form F1b**.

4. Fieldwork procedure

4.1 Overview of data collection process

Data are collected by the field teams for SUS, plots, subplots, measurement points, land use/cover section (LUCS), land use/cover class (LUCC) and interviewees. The main information sources for the assessment are:

- Field measurements and observations.

- Interviews with key informants (external and internal), focus groups and individuals and randomly selected households.

Those two main sources of information imply the use of different methods and approaches that complement and triangulate each other. Depending on the data to be collected and on the field conditions, one of the sources might dominate (e.g. high populated areas versus low populated). Additionally, field observations made by the field teams should be applied to confirm the information obtained from interviews.

The time taken for data collection in each SU is one week (5-6 days) on average but depending on access and vegetation conditions, the time for the inventory varies between 2 to 8 days.

The process for data collection is summarized in Figure , which also outlines the structure of the following sections.

Figure 7. Data collection procedures
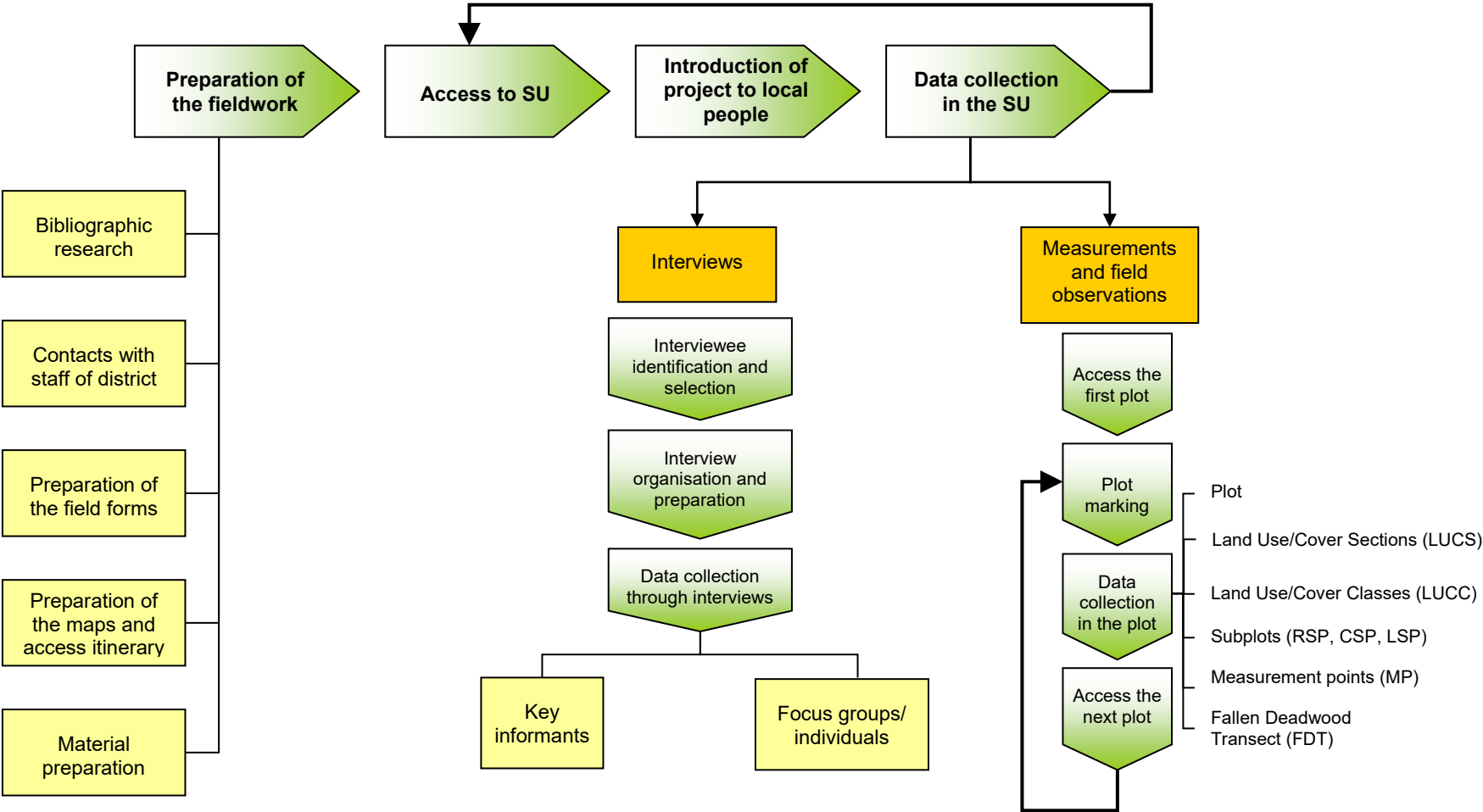
4.2 Preparation for the fieldwork

4.2.1 Bibliographic research

Secondary information is necessary to prepare the field survey and carry out the interviews. Existing reports on natural resource and forest inventory, species, biodiversity, farming systems, national policy and community management issues, local people, customs and livelihoods and socioeconomic context, etc. have to be studied to enable the team members to understand and to build better knowledge on the local realities.

The field team leader is responsible for obtaining this data, but should obtain support of district/provincial authorities to compile and make available information required for NFMA, such as:

- Demographics/population census;

- Crop, livestock, forest, range, soil and water resources and production data;

- Tree species and other biodiversity data;

- Socioeconomic data (markets; infrastructure, health, etc.); and

- Policy and legislation application, especially local byelaws, etc.

4.2.2 Contacts with communities and relevant local government departments

Each field team should, through its leader, start its work by contacting district staff who is involved in local/community based development in the area where the sampling units (SU) are located. These local staff should help contacting the authorities, community leaders and land owners in order to introduce the field team and its programme of work in the area. The local staff may also provide information about access conditions to the site and about the people who can be locally recruited as guides or workers with required local knowledge on relevant subjects (land use practices, forest use, etc.). They should also inform the local people about the project and fieldwork and generate interest in the survey findings by local stakeholders.

A recommendation and identification letter written by the relevant government departments, asking for support and assistance to the field team members should be issued to facilitate the work.

The data related to the land owners and informants must be reported in **form F1b**.

4.2.3 Preparation of the field forms

The Project Technical Unit prepare and print for each team the necessary field forms to cover the SUs assigned to it. For each SU, 6 field forms of one or more pages are needed. The forms are further described in the following section (section 5).

Some information will be filled in before going out in the field: sections for identification of the SU and plots (**header of each page**), general information related to SU location (**form F1, section A**), coordinates of the starting point of the plot (**form F2, section A**), names of field team members (**form F1b**).

The use of secondary data sources, particularly maps, is necessary to determine information such as names of administrative centres (administrative maps), ecological and agro-ecological zones (FAO/FRA 2000 global ecological zones map and national ecological zones maps). Some sections in the form may be filled in during the preparation phase, and be later verified in the field: population data (**form F1**, **part B**), information on distances to infrastructure (**form F1, part C**) and so forth.

The team leader must ensure that enough forms are available to carry out the planned field data collection.

4.2.4 Preparation of the field maps and GPS set up

Maps covering the study area should be prepared to help the orientation in the field. These may be enlarged and reproduced at the appropriate scale, if necessary. These should include topographic (1:50,000 scale, if possible), administrative (1:250,000) and land cover maps (1:250,000).

Prior to the field visit, each team must plan the easiest and least time-consuming itinerary to access the SU. Advice of local informants (local forestry and extension staff, for example) are usually valuable and help saving time in searching the best option to access the SU.

The SU and plot limits will be delineated on topographic maps and if available on aerial photographs or high resolution satellite images. The starting points of the four plots in the SU are to be indicated together with their respective coordinates in a projection system commonly used in the country (such as UTM), in meters (X, Y). A metric projection system is more precise and easier to apply when using the maps, and will be used in GPS. The GPS will be set up accordingly by specifying the projection system (e.g. "UTM") and datum used (e.g. "WGS84").

An enlarged section of the map corresponding to the area surrounding the SU will be prepared (photocopy or printed copy) and used to draw the access route to the first plot.

The plot order (1 to 4) for data collection will vary according to conditions of accessibility. It is determined during the preparation phase, before going to the field.

Reference objects (roads, rivers, houses) that contribute to better orientation of the team in the field are identified.

The starting point coordinates of the plots are entered into the GPS receiver as waypoints. The point name will be given in the following way: (three digits SU number) + "P" (=Plot) + (Plot number) + "S" (= Starting), e.g. for SU 13, plot 3: 013P3S.

One might consider if needed the projection zone (e.g. UTM zone) where the SU is located. An example is given in

Figure (Sudan UTM zones). All SUs West of 36 degrees in longitude East are in zone UTM 36 and while the SUs East of 36 degree longitude East are in zone UTM 37.

Figure 8. Map of stratification with the allocation of the plots for both the Collect Earth and NFI assessment-Sudan.
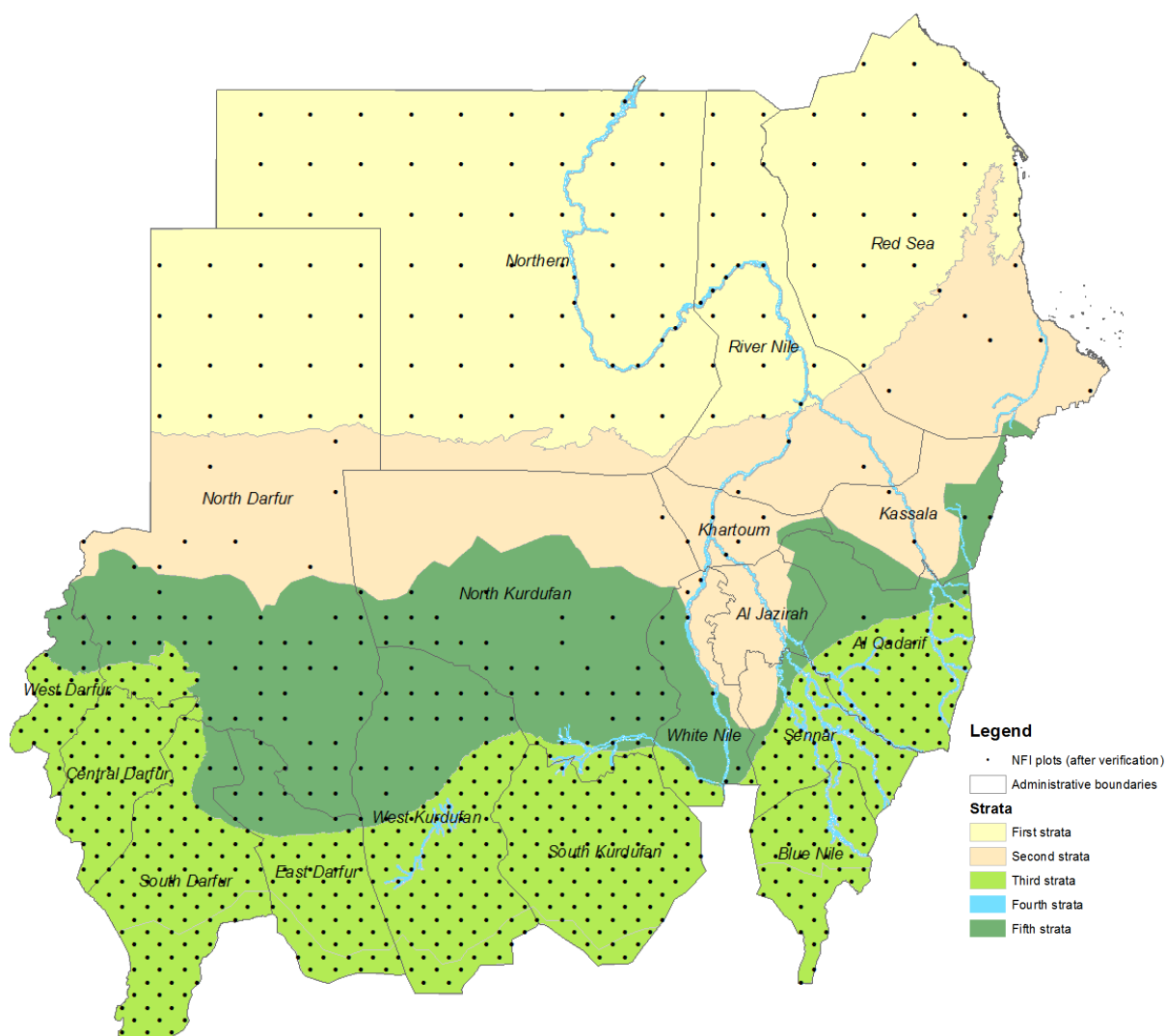
4.2.5   Field equipment per team

In order to conduct the data collection in the field, each field team must carry the equipment that is listed in Table 5.

Table 5. Equipment required for each field team

Equipment needed	Number required	Additional Comments
Measurement tools		
Precision compass (360°)	1	- High precision - In degrees - Waterproof and resistant

GPS receiver (Geographic Positioning System) and extra batteries	1	- Possibility to calculated average point - Optional antenna
Tree height and land slope measuring equipment	1	-Clinometer with 15m, 20m and % scales to measure both tree height, in meters, and slopes, in percent
320cm / 10m diameter tapes	2	- Graduated in meters - Diameter measurement on one side, distance measurement on the other side - Auto rewind
30-50m measuring tape or rope/ chain marked at every meter	1	Metric (Self-rolling)
Hypsometer Vertex IV	1	For measurement of distance, height, slope.
Coloured flagging tape	Several rolls	Used for marking and retracing the access route
Machete	2	
File	1	
Waterproof bags	2	To protect measurement instruments and forms
Spade / Augers	1	For soil profiles and soil sample collection (optional)
Callipers / ruler	1	Metric For shrub stems and deadwood branches diameter measurements
Tablet		For data recording
Clothing		
Boots and waterproof outfits	For each permanent team member	Size to fit team members
Leather gloves	1-2 pairs	
Helmet	For each permanent team member	Optional, for are where there are risks for branches to fall
Documents, papers		
Clipboard	3	To take notes
Topographic maps and field maps	As necessary	
Field forms	As necessary	
Field manual	As necessary	
Notebooks	3	

Pens and markers	As necessary	
Hand calculator	1	
Flora and fauna species lists and identification keys	As necessary	On forestry, pasture, range, weeds, pests and others are relevant topics
Press and newspapers	As necessary	For collection of samples (plant/ leaves)
Other equipment (camping, security, communication…)		
Flashlights and batteries	As necessary	
Knives	1	
Camping equipment and cooking utensils	1	Food if required
First aid kit	1	With phone numbers of hospitals / emergency
Cell phone and/or radio	1	For communication with supervision or in case of emergency

4.3 Introduction of the project to the local people

If the SU area is inhabited, the team must establish contacts with local people on arrival to the site and meet with contacted persons, village representative, closest government institution in place and owners. Except in very remote areas, the local population should be contacted before visiting the SU, in order to inform them about the visit and request permission to access the property. An introductory meeting should be organized to briefly and clearly introduce and explain the aim of the visit and study to generate interest and avoid misunderstandings or raising false expectations. A map or an aerial photograph, showing the limits of the SU, may be very useful to facilitate the understanding. It is important to ensure that both local people and the field team understand which area will be studied. Cooperation and support from local people are essential to carry out the fieldwork. It is easier to achieve this support if the first impression is good. Nevertheless, it must be stressed that the fieldwork consists only in data collection for use by decision makers at national/provincial levels and is not a local development project. Care must be taken to ensure that no commitments are made during discussions and interviews.

Some key points about the project introduction are mentioned in Box 1.
Besides the presentation of NFMA, this initial meeting aims at resolving logistical matters. After the general introduction, access to the land, especially to forest and protected areas, fieldwork and interview schedule, as well as food and accommodation issues should be discussed. This meeting should also give the opportunities to start collection of secondary data and to identify key informants and user groups for focus group interviews.

Box 1. Key points to be stressed when presenting the assessment to the local people

❖   This assessment is part of a larger programme for land use data collection at global and country level.

❖   There is limited information on the local use of land and natural resources and the problems that might exist at the local level. The collected land use information will be used by the country and the international community.

❖   The objective is to generate reliable information for improved land use and resources management policies that take into account peoples' reality and needs. Such information could help the government to plan and improve on food security and poverty reduction.

❖   The sampling units (SU) where the survey will be carried out are distributed systematically throughout the country. XX SUs were selected in the country.

❖   The results from the study will be shared with the local authorities and communities after the data analysis. A meeting will be held to present the results to local authority. Posters and a copy of the final documents and reports will be sent to regional governmental offices.

❖   The study will use a participatory approach therefore involve local users of resources in data collection and understand how they manage their resources.

❖   The data are collected from two main sources:

1) Measurements and observations of land use and management practices in forest, agriculture lands , rangeland, pasture including livestock, wildlife and trees outside of forests; and

2) Interviews with key persons, individuals, focus groups and randomly selected households. .Measurement to be undertaken includes: tree diameter and height; species composition (forest, crops and plants); soil and water quality; and land degradation indicators.

❖   The field team should be especially interested in the perception of local land users on land use changes and will therefore interview them about the main products extracted from land; land use related problems; and local solutions/innovations.

❖   Some or all of the SUs surveyed in the country will be monitored in the future, and on a periodic basis (e.g. every 5 years) with the aim of assessing land use changes and their impacts and implications.

4.4   Field data collection

4.4.1   Interviews

The following sections present the procedure on the identification and selection of persons to be interviewed, the interview's preparation, organization and conduction.

The interviews will be carried out with the following target groups: key informants; focus groups or individuals and randomly selected households. A summary of the interview procedure is provided in the Table 6.

Table 6. Interview procedure

Target group to be interviewed	Who are they?	How to identify them?	Where?	When? (see Figure, p. 35)	Information
Key informants	• **External key informants**, includes officers from local government departments, NGOs, extension workers and local administration representatives. • **Internal key informants,** includes the community members who possess an overall and in-depth knowledge of the local use and users of natural resources, such as community leaders, community representatives, school teachers, customary leaders, community based organizations and owners.	• Based on their official function and personnel involvement in the areas development. • Suggestion from local government departments, NGOs and community members.	• At the office • At the house • At the site/village	• During the planning phase of the fieldwork • Before reaching the site • When arriving to the site • During the fieldwork activities	• Logistics • Background information on the SU • Information on the people living in the SU or in the surroundings, including household locations • General information on the distance and access to the SU/plots • General information on the Land Use/Cover Section (ownership, protection status, management, ecological problems) • General information on local uses and importance of forest products and services • Information that will help identifying user groups. This information will help select individuals and focus groups to interview • Queering where questions were left blank after data collection • For verification and cross examination of data collected from households

Target group to be interviewed	Who are they?	How to identify them?	Where?	When? (see Figure, p. 35)	Information
Focus groups or individuals	Representative groups or individuals living and/or using forest / land resources in the area. Examples of user/focus groups: Forest and tree users; logging companies Farmers and pastoralists managing various combinations of crop, livestock, rangeland and agroforestry systems Fishermen – using water resources for fishing and aquaculture Women Men Youth Owners Tenants Occupants Nomads / transhumant, etc. Long-term residents (for historical changes) Hunters and gatherers	• Recommended by key informants • Identified by applying rapid rural appraisal to identify stakeholders (see section 6.7.2) • Gender balance in resource uses should be considered when selecting focus groups • Locally recruited team members can be used as focus individuals	• At their house or in the village • In the field (transect walk, persons working in the field) • Close to or within the SU	• During the introduction to the local people • Arranged meetings (group or individual meeting) parallel to and after the data collection in the plot	• Information on local population (history, etc.) • General information on the land use/cover section (ownership, protection status, management, ecological problems, etc.) • Products and services • Management and uses, of products and services derived from the different land uses/ resources • Historical information related to the changes in the area • Temporal changes in land resources, biodiversity and livelihoods, invasive and threatened species • Change in ecosystem services and functions

A. Identification and selection of informants and interviewees

As previously mentioned three major informant categories will be interviewed:

- Key informants;
- Focus groups and individuals; and
- Randomly selected households.

In sparsely populated areas and in the absence of local inhabitants or sedentary populations, many of the social economic variables will essentially be collected from observations or from key informants.

All the persons interviewed (key informants, individuals and households) and providing information on the SU must be mentioned in the list of persons involved in the assessment (**form F1b**).

A1.   Key informants

These are external (living outside the area) or internal (living in the area) individuals with particular knowledge about the area, the land/ natural resource use and the local community. They do not have to be local land resource users themselves.

In the process of planning of the fieldwork, local government officials, leaders of local development organizations and local administration will be contacted for logistics and planning purposes. They may provide very useful background information and may be selected as **external key informants**. Often they have knowledge about conditions and accessibility to the site. They may also provide literature and other existing data.

Some individuals within the community may possess an overall and in-depth knowledge of the local settings, costumes and use of natural resources and may serve as **internal key informants**.

A2.   Focus groups and individuals

These are representative persons of key stakeholders or land/resources user groups that are of particular importance and/or significance in the area. User groups are defined as people who relate to and use the forest and tree resources on a frequent basis. These people live in or close to the SU. They may be interviewed in groups (focus groups), or individually (focus individual).

Upon arrival to the site, the main resource user groups, or stakeholders, must be identified. This task may be carried out through discussions with village representatives, community members, and key informants, or through visual exercises. Stakeholders identification and the understanding of the relationships between users and resources can be undertaken through the Rapid Rural Appraisal (RRA) exercise, as explained in Annex section (Venn diagram). It is recommended to carry out such an exercise during the introduction meeting, so that an overview of the key user groups is established early in the stay.

Representativeness is a complex issue to be aware of when identifying land/resource users or stakeholders to interviews. Many users share common characteristics and are classified within a common group, for analytic purpose. Nevertheless, wide variations in cultural and social factors (gender, age, wealth, status, religion, etc.) often exist and should be taken into account. Therefore it is recommended to identify stakeholders together with several local

participants in order to appropriately define the user groups. Many different groups might be identified but the assessment must put emphasis on the individuals and groups that use forests and trees products and services. The gender aspect should be emphasised as crucial when selecting focus groups and conducting interviews as males in some cases dominate discussions, which in turn might result in biased results.

B. Interview organisation and preparation

The Figure gives an overview on how interviews with key informants, focus groups and individuals, and the household survey should be scheduled.

Figure 9. Suggestion on how to organise interviews during the field work activities
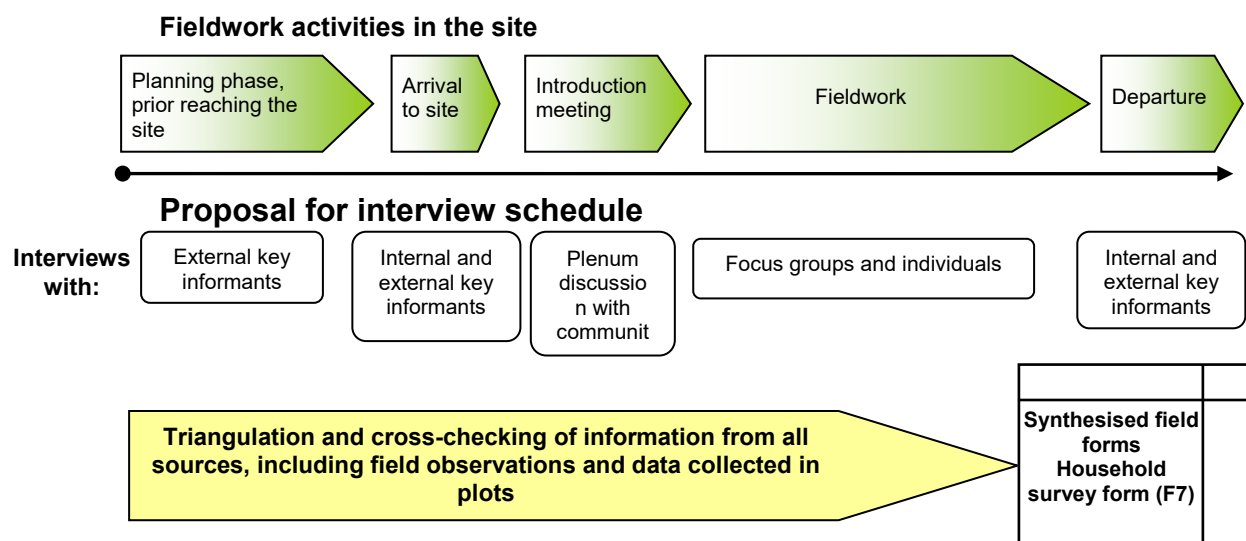
Some general information required in the field forms may be completed through interviews with **external key informants before going to the field** (during planning / preparation phase), especially SU information (**form F1**).

Subsequently, further data should be collected through interviews **in the field** with internal key informants, focus groups/individuals and households:

- **Internal key informants** may be contacted and interviewed when arriving to the site to establish some basic knowledge about area, local population (e.g. user groups) and land uses. Key informants might also be valuable sources for information throughout the stay in the site and for cross-checking information that is received from other sources (both from interviews and field observations/measurements).

- **Identified focus groups or individuals** (see previous section on how to identify them) will be interviewed throughout the stay in the site. Nevertheless, as the information received from a group interview might serve to better understand and approach households in interviews, it could be advantageous to carry out focus group interviews early in the interview schedule. The introduction meeting might serve as first opportunity for a group discussion and platform for a general discussion with the present population on historical changes, existing land use patterns, etc. Other group interviews, targeting focus groups, will be carried out subsequently to gather data on those specific users.

The interviews with key informants, focus groups and individuals will be carried out by some

of the field team member working in the field measurements/ observations so they can refer to what they have seen in the field. Some of these interviews can also be carried out directly in the plots, with people met in the field during the measurements, or with the local guide/ temporary assistants.

In general, it is recommended that the interviews be scheduled to fit with the daily work-schedule of the local people. Also, the information generated from household surveys should be cross-checked with and complemented by other sources (key informants, focus groups/individuals and field observations) and vice versa.

At the end of the field work in the SU all data collected about the SU, plot, Land Use/Cover Section (LUCS) and land use SU from the various interviews should be interpreted and synthesized onto the field forms (**F1**, **F5** and **F6).**

C. Data collection through interviews - Interview techniques and tools

Data will be collected or validated/ cross-checked through interview. The source of this data will vary according to the type of data. The table below summarizes what data may be collected from what sources. This table is indicative; one type of information might derive from one source in one SU and from another in the next.

Table7. Data to be collected through interviews

Interviewee category	F1a			F1c		F1d	F3		F4a		F5			F6**		
	Section A: SU location	Section C: Population	Section D: Proximity to infrastructure	Section G: Catchments condition	Section H: Water use point	Section K : list of households	Variable 56a: common/local sp. name	Variable 60: years since cut	Variable 77a: Common/local sp. name	Variable 56a: Common/local sp. name	Section A: General	Section B: Forest and OWL management	Section C: Crop management	Section A: Products harvested in LUCC	Section B: Services provided by LUCC	Section C: Biodiversity indicators
External key informant	+ +	o	o	+ +		o										
Internal key informant	o	+ +	+ +	+ +	+ +	+ +	o	o	o		o	+ +	o	o		
Focus individual*		o			o		+ +	+ +	+ +	+ +	+ +	o	+ +	o	o	o
Focus group*		o			o						o	o	o	+ +	+ +	+ +
Household														o	o	o
Observations			o	o	o		o		o	o	o	o	o	o	o	o

Notes:

+ + *= Main information source*

o *= Complementary information and for cross-checking purposes*

* *Interviews with focus individuals should complement focus group interviews or substitute these when not available. Focus individuals are also the local guides/ workers recruited to help in the work in the plots.*

** F6*: For each information source (focus group or individual or observations) a separate form F6(p) should be used to record primary data. Focus groups should have priority. A summary will be made in form F6.*

General explanations on the data collection techniques and group discussions, interview recommendations and examples of questions are provided in Annex.

In general, the questions should be clear and simple in order to be easily understood by the

interviewee. They should be asked in the order that is the most natural following on from informants' responses and should not be repeated. When formulating the questions, interviewee's culture and language must be taken into account. Historical information related to the changes in the area may be a good starting point for the discussions.

Tools and techniques that may be adopted include:

- **Stakeholder identification analysis exercise (Annex, section):** This should be carried out as an initial exercise (e.g. during the introduction meeting) and will help identifying user groups for focus group interviews. It might be merged with the *Participatory analysis* (see below) and serve as a source for generic information about the use of natural resources, forest products and services, agriculture production, environmental problems, etc.

- **Participatory analysis of aerial photographs or maps (Annex, section 6.7.3):** This exercise may stimulate discussions with the focus groups on a number of variables and could be carried out during the introductory meeting or later with identified focus groups. It will provide important information on both the use and management of resources (What uses? Who uses what? Where? How? etc.) and the logistics on how the field team can access the SU.

- **Interviews within the sampling unit itself (Annex, section 6.7.6):** This exercise could be done by organizing a transect walk or by collecting information from locally recruited workers who participate in the plot measurement work. This will allow one to link collected data with the location of the SU/plot/LUCS/LUCC in the field. This exercise can also be applied during the household survey for better understanding household practices and uses of natural resources.

- **A products and services identification exercise (Annex, section 6.7.7):** This exercise may be organized to collect data from the focus groups, for example, on forest, fish, crop, wildlife products, services and users.

- **Cross-checking (Annex, section 6.7.4):** Cross-checking and triangulation should be applied as much as possible to verify/validate information from all different sources e.g. between different types of interviews and between qualitative information from interviews and quantitative data collected in plots or direct observations (Annex, 6.7.5).

4.4.2 Field plot measurements and observations

A. Access to plot

For each sampling unit, the plots will be located with the help of the metric coordinates (in the projection system adopted for the assessment) and topographic maps (and aerial photographs/satellite images, if available), on which the plots have been delineated (field maps). Some reference points that facilitate the orientation in the field (e.g. roads, rivers...) will also be identified on the field maps. It is also important to hire a local guide who can provide useful information on how to access the plots more easily.

The order in which the plots are inventoried (usually already decided during the planning phase) depends on the accessibility but the plot code (1 to 4) and orientation must be respected (the data collection process must start at the plot starting point).

Navigation in the field to arrive to the first plot starting point will be assured with the help of

a GPS where the starting points of each plot have been pre-registered as waypoints, using the "GOTO" function (see GPS guide in Annex 6.3). The GPS normally indicates the straight distance and bearing to the active GOTO waypoint. But in some cases the path to the waypoint requires meandering around topographic obstacles (see Figure) or following as far as possible roads or existing paths.

Figure 10. Path to a waypoint using a GPS GOTO function
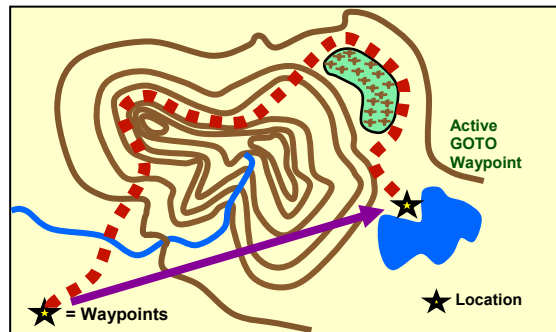
While accessing the first plot, **form F1, section D** must be filled in. The coordinates of the departure location on foot towards the first plot (usually from the vehicle) must be read on GPS (or on the map, if the GPS does not capture a signal).

Figure 11. Access to SU - Starting position coordinates and access time (form F1 Part D)

During the access to the plot, photographs will also be taken for relevant sites (such as road/path junctions, settlements) that can orientate to arrive in the future to the sampling unit. For these reference points to access path, the coordinates, bearing and a brief description must be recorded in the table at the bottom of **form F1** (see Figure). A sketch representing the itinerary covered will be drawn on the site map (to be attached to the field form), with indications of the reference objects that will facilitate relocation of the plot (see example given in Figure . The coordinates of each reference point are read on the GPS and recorded on the form and reference photos may also be taken and their codes are specified on the form. If required, the flagging coloured tape will be placed along the access path, on trees, visible enough to facilitate the return out of the SU.

Figure 12. Access to Sampling unit sketch (Field form F1a/R)
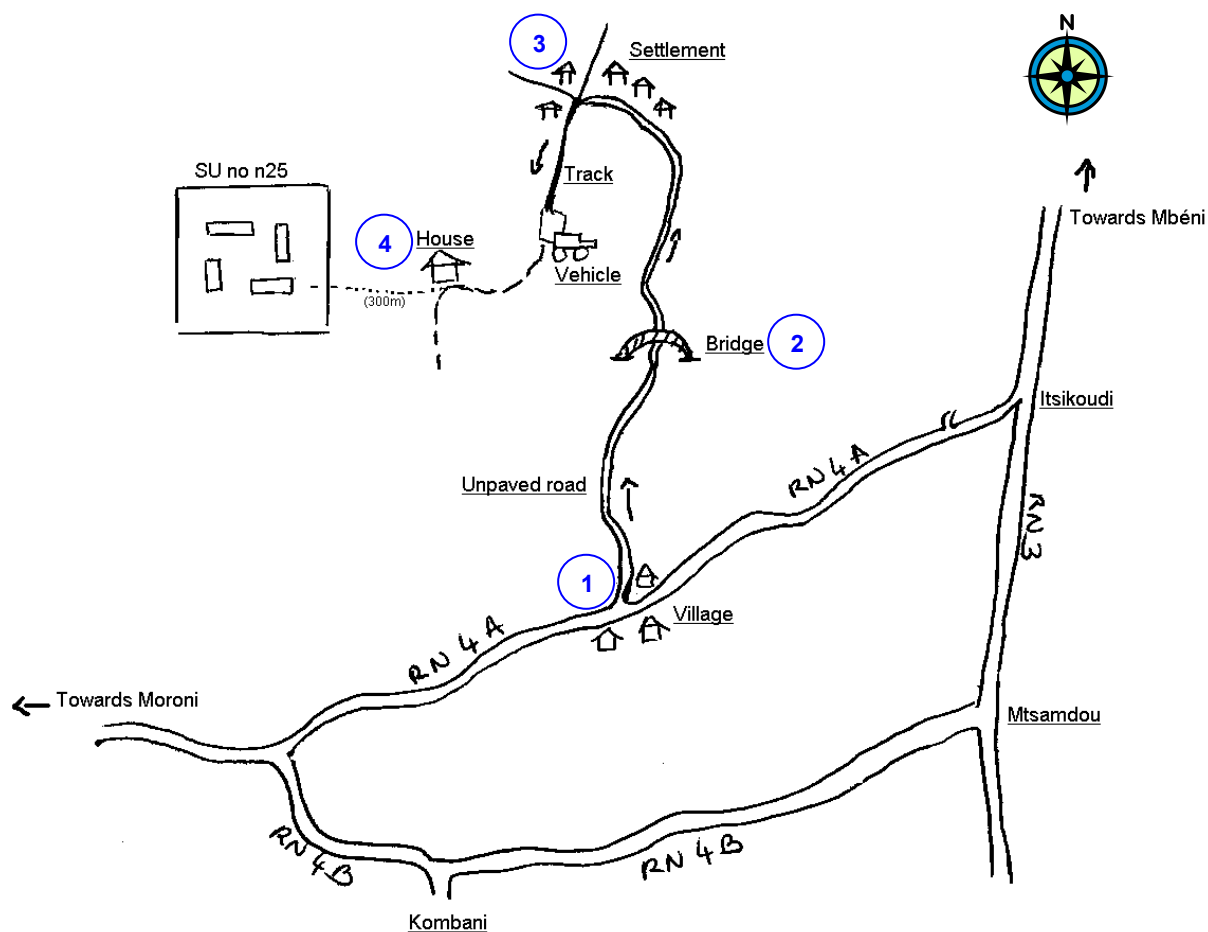
Table 8. Example of reference point of access path table (Form F1, Part D) (SU N°25)

Reference points of access path (Route sketch to be attached)

35. ID	36. Description	37a. X (m)	37b. Y (m)	36b. Photo #	36d. Bearing
1	Road crossing between the RN4A and a unpaved road, at a village	0174162	1657172	1	28°
2	River bridge	0174024	1657351	2	54°
3	Settlement at the end of the unpaved road and crossing with tracks	0174001	1657123	3	85°
4	House	0174162	1657172	4	28°

If the GPS signal is lost at the moment of locating the starting point of the plot, the team can stop and wait the signal to be established again or move to a location with a clear view of the sky (dense foliage, buildings can block the signal) to get the coordinates, and from there navigate using a compass and measuring tapes, calculating distances to the plot starting point for the East-West and the North-South axes (see below).

When the team is close to the starting point the GPS (about 10 metres distance), reading will not stabilised. At this moment, to establish a well defined starting point without subjectivity, the team:

1. Stops and get the position coordinates using the "average position" function of the GPS;

2. Calculate the difference between the actual position coordinates and the plot starting point coordinates (northing and easting);

3. Move to the East or West for a distance corresponding to the difference between the easting (= X coordinates), using the measuring tape and compass (bearing 270° or 90°):

    if the easting of the actual position is lower than the easting of the plot starting point position, then the team will move to the East (bearing 90°);

    on the contrary, if it is higher, then the team will move to the West (bearing 270°);

4. Move to the North or South for a distance corresponding to the difference between the northing (= Y coordinates) using the measuring tape and compass (bearing 0° or 180°):

    if the northing of the actual position is lower than the northing of the plot starting point position, then the team will move to the North (0°);

    on the contrary, if it is higher, then the team will move to the South (180°).

Once arrived at the plot starting point location, the starting date and time of work in the plot will be recorded in **form F2, section B.**

B.   Establishment of permanent plot

The position of the starting points of all 4 plots in the SU need to be precisely located marked with a permanent marker and properly referenced to enable their easy relocation in the future.

When arriving at the starting point of the plot a permanent marker (galvanized metal tube) is inserted fully into the ground so it is no longer visible. The marker must be placed exactly on the position of the starting point of the plot. In cases where obstacles obstruct or prevent such exact location (tree, rock, river, house, etc.), the permanent marker should be placed as close as possible to the starting point of the plot (see below).

The permanent marker will not be possible in cropland; there attention should be paid on providing good reference points/objects.

Marker location data must be recorded on the field form (**F2, part C**) together with a starting point description of the plot in order to enable relocation in the future.

The coordinates of marker position are determined using the GPS (average position). An identification code will be assigned to name each one of the points identified by the GPS according to following: (SU number) + "P" (= Plot) + (Plot number) + "M" ("Marker"), e.g. for SU 13, plot 3: 013P3M. A photo of the Marker position may be taken.

If for any reason (presence of rock, river, house …) the marker could not be placed at the starting point, the distance and compass bearing (in degrees) of the plot starting point should be measured from the marker location.

In addition, three prominent reference objects (rock, largest tree, houses, top of mountain, etc.) must be identified and the direction (compass bearing in degrees starting from the marker location) and distance from the marker should be measured. A photo from the marker should be taken for each reference and coded (running photo number within SU) (e.g. 6th photo taken in the SU = 6).

These indications are reported on a sketch (plot starting point plan, var. 43) where the reference points and the starting point of the plot are indicated. A brief description of the reference points will also be provided in a table (the columns containing the bearing and the distance from the marker position may be filled in according to the sketch indications after the fieldwork) (see

Table 9 and Figure).

Figure 13. Marker description (sketch and table) (Field form F2 part C)
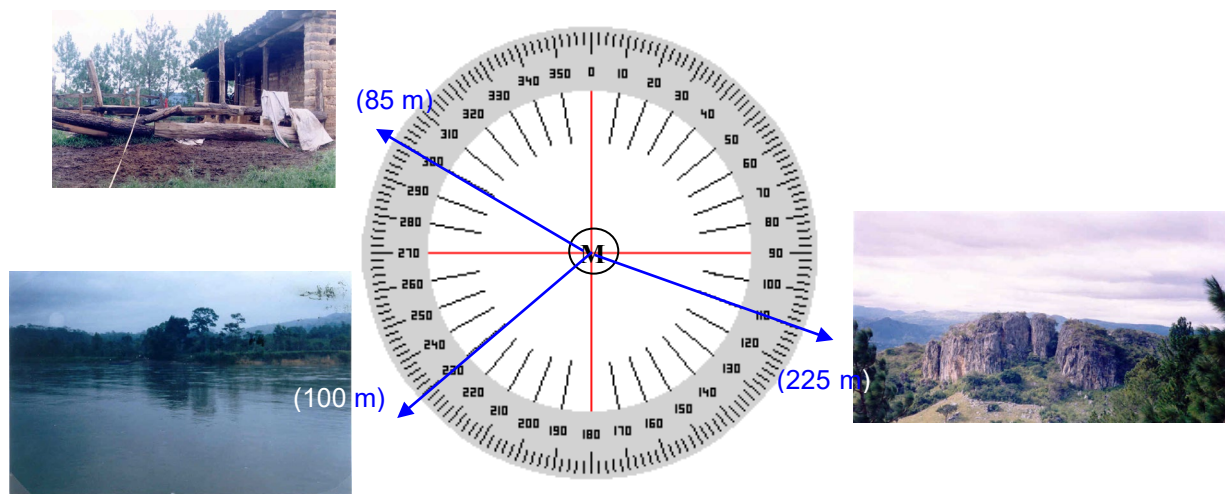
Table 9. Example of reference point of access path table (Form F1, Part D) (SU No13)

Reference points surrounding Marker position

44. ID	45. Description	46. Bearing* (°)	47. Distance* (m)	36c ID Photo
1	South West corner of the House of the Mr X family.	300	85	5
2	Summit of mountain "AA".	110	225	6
3	Inner curve of river "BB".	230	100	7

C. Summary of data collection procedure in the plot

The data collection starts at the plot starting point and continues in the predefined plot direction (see

Table 2 and Figure 2). The progress along the central line will be made with the help of the compass and 50 m meter tape (or metal string), to get a well define central line. In order to facilitate the bearing, flagging coloured tape may be attached to cut branches trees stretched along the central line, as the field team advances. It is necessary that slope corrections be made using the Table (given in Annex 6.4) in order to obtain a more accurate measurement of horizontal distances.

Measurements involve both left and right sides from the central line on a 10 m wide extension. Flagging coloured tape may also be placed on the corners and limits of the plot (at 10 m from the central line) as the team advances, in order to easily identify the trees/ shrubs and other target objects within the plot.
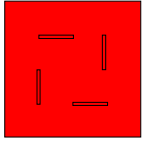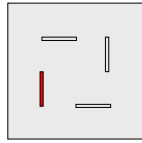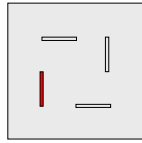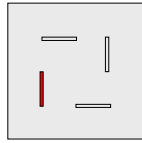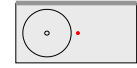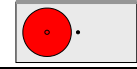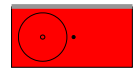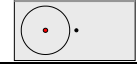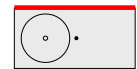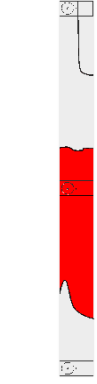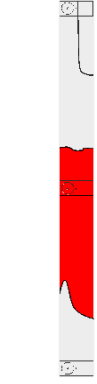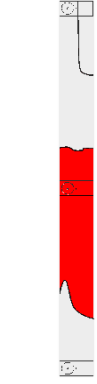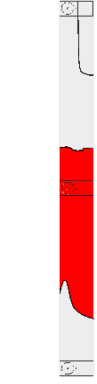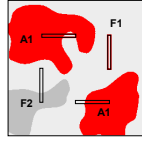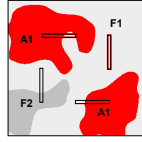
All the data collection process has to be well documented with photographs. A photograph has to be taken for each land use/ cover class found in the plot. Pictures for any problem encountered, unique features or environmental problems should be taken during field work.

Different variables are collected depending on data collection levels:

- **Plot**: identification of different land use/cover sections (LUCS) and measurements of trees and stumps with a Dbh ≥ 20 cm in forest, or ≥ 10 cm for the trees outside forest. A plan of the plot indicating in particular land use/cover sections limits must also be completed.

- **Land Use/Cover Section (LUCS)**: corresponds to the land use/cover sections identified along the plot. Information collected at this level includes: general information related to the LUCS**;** forest and other wooded lands management practices (harvesting, silviculture, etc.); and structure, as well as crop management practices.

- **Land Use/Cover Classes (LUCC):** corresponds to each land use class found in the SU (in all 4 plots). Information on forest and trees, on environmental services, pests and diseases, invasive and threatened species, wildlife abundance, and land use change is collected at this level.

- **Rectangular Subplot (RSP):** shrubs (in all LUCC), trees with 20 cm > Dbh ≥ 10 cm trees (only in forest LUCC), indicator plant species and non wood forest products (NWFP) are inventoried at this level.

- **Circular Subplot (CSP)**: data on tree regeneration (Dbh < 10 cm and height ≥ 1.30 m) data are collected at this level (only in forest, OWL and woodlots) .

- **Litter Subplot (LSP)**: at this level, data is collected on litter, which includes all non-living biomass with diameter less than 10 cm.

- **Fallen Deadwood Transect (FDT)**: measurements of fallen deadwood branches (≥ 10 cm) are done along the transect lines.

- **Measurement point (MP):** topographic and soil data is collected at the three measurement points**.**

The Table 10 summarizes observations and measurements to be done at each data collection and indicates also in which field form the data is recorded.

Table 10. Measurements and observations by data collection level

Data collection level		Measurements and observations			Field forms (section)
		LUCS = Forest	LUCS = Other Wooded Lands and Woodlots (0.2-0.5ha)	LUCS = Other lands	
SU (tract)		- Localisation and access to SU - Population data - Proximity to infrastructure			**F1a**
		- List of the persons involved in the inventory			**F1b**
		- Direct and indirect observations on wildlife - Water use and management			**F1c, d….**
Plot		- Access to plot and working time in the plot - Plot plan (LUCS limits, road and river intersections…)			**F2**
		- Measurement of trees with Dbh ≥ 20 cm	- Measurement of trees with Dbh ≥ 10 cm		**F3a** or **F3b**
Measurement Point (MP)		- Soil and topography			**F4** (section A)
Circular Subplot (CSP)		- Count of trees with Dbh < 10cm and height ≥ 1.30m, by species	None		**F4** (section C)
Rectangular Subplot (RSP)		- Measurement of trees with 10cm ≤Dbh< 20cm	None	None	**F3a** or **F3b**
		- Shrubs, bushes (count or measurement by species)		None	**F4c** (section E)
		- Presence or abundance or count of indicator plant species, NWFP		- Indicator plant species	**F4a/b** (section C)
Litter Subplot (LSP)		- Litter depth and composition			**F4a** (section B)
Fallen Deadwood Transect (FDT)		- Measurements of fallen deadwood branches (diameter ≥ 2.5 cm)			**F4b**
Land Use/Cover Section (LUCS)		- Land Use/Cover class - General information related to the area (designation, land tenure…) - Vegetation cover (trees, shrubs, grass) - Environmental problems, fires, erosion - Grazing activities			**F5** (section A)
		- Stand structure and management: harvesting, silviculture, management plan... - Human-induced disturbances		- Crop management practices	**F5** (section B and C)
Land Use/Cover Class (LUCC)		- Use of forest resources and trees outside forest (forest products) - Environmental services provided by trees and forest - Pest, diseases and invasive species; threatened / Extinct species, wildlife abundance - Land use/cover change, conversion processes			**F6**

D. Details on plot measurements

D1. Plot plan

All details related to the plot must be indicated in the plot sketch in **form F2, section D**. In particular, the following characteristics will be drawn (see also example in Figure):

- limits between land use/cover sections, including the code of the land use/cover class code (inside the corresponding sections);
- crossing of water courses and infrastructures (roads, paths, fences), including the code and width of the road/water course.

In addition, the sketch must also include all the information and observations that help interpreting the plot.

D2. Tree measurements

In forest:

- All trees living or dead, standing or fallen with at least 20 cm of diameter at breast height (Dbh) found within the plot are measured (Table) and the data is recorded on field form **F3a** or **F3b**.
- For smaller diameters, measurements are carried out within the subplots, located at every 120 meters (see Figure 2). The size of trees measured varies according to the subplot level (RSP or CSP) where the measurements are made (see Table). Data are recorded in **F3** (for RSP) or **F4** (for CSP)

In the LUCS not classified as "forest":

- All trees living or dead, standing or fallen and with a Dbh ≥ 10 cm are measured within the plot, and the data are recorded on form **F3a** or **b**.
- Trees with smaller diameter (Dbh<= 10cm) and height ≥ 1.3 m are counted in CSP only in lands classified as other wooded land or woodlot and data are recorded on form **F4**.

Stumps:

Stumps are measured as for trees, following the same diameter criteria. Stump diameter is then measured at breast height or at the top of the stump if less than 1.30 m above ground level. In this case, the height of the stump (where the diameter is measured) is recorded in **F3a** or **F3b**.

Borderline trees: Trees located at the border of the plot will be considered as inside the plot if at least half of the diameter of the stem base is inside f the stem centre is exactly on the plot limit then it will be considered once inside, once outside (Figure). If the tree is fallen, it is considered inside the plot if half of the base of its stem was inside the plot before it fell.

Figure 14. Borderline trees cases
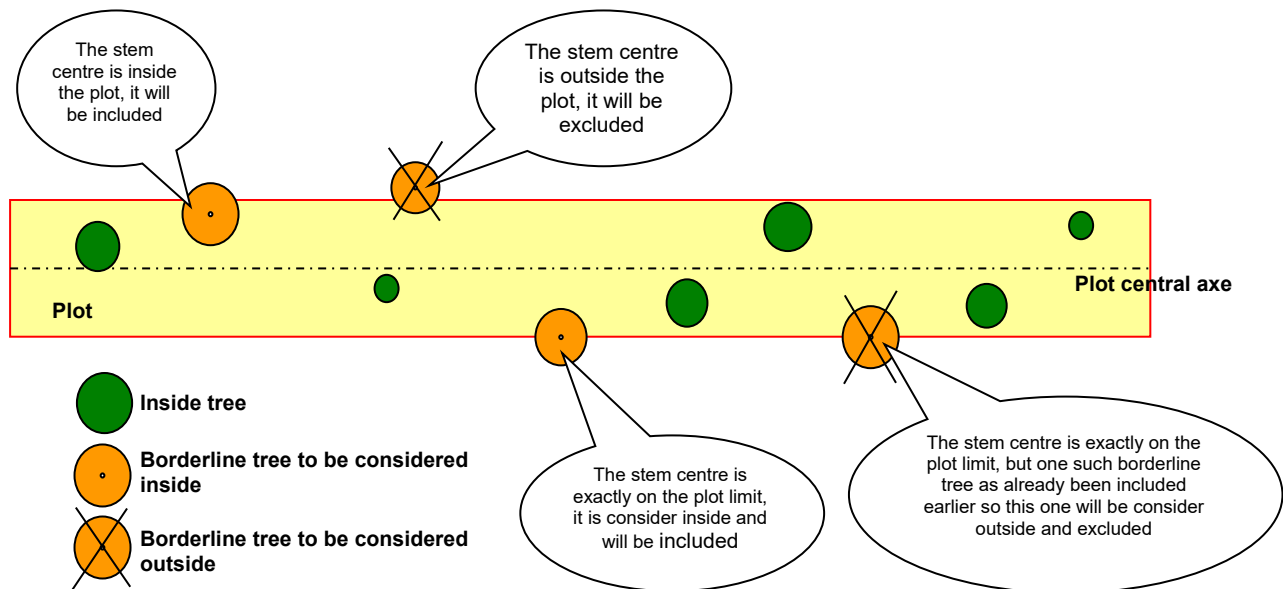
Small tree and tree regeneration (tree height ≥ 1.3 m and Dbh < 10 cm) are only counted by species within CSP. Only tree species (species reaching 5 m height *in situ*) are recorded.

For trees with diameter (Dbh) ≥ 10 cm, within RSP or within the plot, collected data are more complete and include, besides the species identification, height, diameter, health and tree quality.

Table 11. Trees and stumps measured per level and corresponding forms

Level	Measured trees/stumps		Measurements	Field form
	Forest	**Other LUCC**		
Plot	Dbh ≥ 20 cm	Dbh ≥ 10 cm	Species, location, diameters, total height, health, quality	F3a or F3b
Rectangular Subplot (RSP)	DBH ≥ 10 cm	None	Species, location, diameters, total height, health, quality	F3a or F3b
Circular Subplot (CSP)	Tree height ≥ 1.30 m and Dbh < 10 cm	Tree height ≥ 1.30 m and Dbh < 10 cm (only in OWL and woodlots LUCC)	Number of trees by species	F4 (section C)

Indications on tree diameter and height measurement methods are provided in appendix (see section 1.1).

D3. Deadwood and litter measurements

Dead trees, standing or fallen to the ground, are measured as for living trees, as indicated in the above section, and recorded in the form **F3a** or **F3b**. The decomposition status of the stem is also registered.

Fallen deadwood branches are measured along the Fallen Deadwood Transect line located at the end of each rectangular subplot. The branches included in the measurements are:

- on the ground and not attached to a tree stem;
- with a diameter above or equal to 2.5 cm at the intersection point of the transect; and
- crossing the transect line through at least half of its diameter.

The diameter of the branch at the intersecting point is measured using a ruler, diameter tape or a caliper and the decomposition status is determined. The data is recorded in the form **F4**.

Litter is defined as all dead organic surface material on top of the mineral soil. It includes all non-living biomass, other that deadwood with a diameter equal or above to 2.5 cm. The litter is made of woody (twigs, small branches with a diameter less than 2.5 cm, bark...) and non woody components (dead leaves, dead grasses/herbs, and seeds, fruits, animal manure, insect detritus and other comminuted organic matter) that have fallen to the ground, in various states of decomposition. The average depth of the litter layer in the Litter Subplot and its main composition are recorded on form **F4**.

D4. Soil measurements

The biophysical and hydrological properties of the soil are assessed at the **measurement points** (centre of Rectangular Subplots, i.e. 3 per plot, see Figure 2).

Two methods are proposed to collect data on soil, depending on information requirement and available funds: based on observations carried out in the field (soil visual assessment), and soil sample collection, which implies subsequent laboratories analysis. Both methods might also be applied jointly as some of the information they provide is different.

For both methods, the LUCS number should be recorded for each soil sampling point as well as site variables like slope, slope orientation, relief and flooding characteristics as well as soil variables including topsoil and subsoil depths.

- **Soil Visual Assessment (VS-Fast)**

Soil measurement methodology is adapted from the visual soil field assessment methodology of FAO. The methodology was first designated with the prime aim of providing cheap, repeatable, easy and immediate mains of land degradation assessment.

The rapid Soil Visual Assessment technique (VS-Fast) is used to observe a set of soil visual descriptors such as the soil surface, the top layer of soil and the tilled layer to about 30 cm in depth and assign a score for each of the properties.

More details on soil visual assessment techniques are provided in Annex 6.5.

D5. Data collection on products and services

Data on forest, trees outside of forests, crops and fish products is collected for each land use/cover class (LUCC) present in the sampling unit (SU). The information will be reported in **form F6.** If there are several LUCS with the same LUCC in the SU, the data is grouped and recorded on the same sheet.

This information will essentially originate from interviews with local people or from people accompanying the field team in the field, but should also be verified/ complemented through direct field observations. Interview and group discussion techniques and instructions are included in section 4.4.1

D6. Shrubs measurements (optional)

Shrubs within the Rectangular Subplot (RSP) are inventoried and these data are recorded on field **form F4 section D**. Collected data include species, average diameter at 0.5 meters, height and number of stems.

D7. Plant indicator species inventory (optional)

Plant indicator species are identified in the Rectangular Subplot (RSP) not classified as cropland or water and data are recorded on form **F4 section B**.

These species might indicate poor, medium or good forest, cropping, rangeland (or other) conditions.

E. End of data collection work in the plot and access to the next plot

Once the work in the first plot is completed, the time is recorded on form **F2** (section B) and the team need to access the second plot. It may be possible to directly access the plot with the help of the GPS. Otherwise, for example in dense forest, it may be assured by using the compass bearing and measuring 250 m (horizontal distance) along the central line of the previous plot. If the starting point of the next plot to be reached is not accessible on a straight line, the obstacle must be bypassed using auxiliary methods that allow finding the original line.

4.5 End of the work in the sampling unit

When the work in the Sampling Unit is completed, the field team registers on form **F1 (cover page)** the date when leaving the SU, to go either to the next SU or to a base. Summary notes on the work carried out in the SU, stressing difficulties encountered while carrying out the field inventory in the SU will be compiled.

The field forms should be well-organised, filed and thoroughly checked by the field team leader, to ensure that all fields are duly completed and that there are no inconsistencies. Then they will be handed over to the supervision team for review and quality control. If they have to be sent by mail/ courier, they should first be scanned (or photographed) and/or photocopied. When the field team has access to a computer, the photographs should be uploaded and renamed as follows: "SU number" + "running number of photos in the SU" (should be the same numbers as the one used in the field forms). Then they should be copied to a CD or DVD, and communicated to the supervision team.

5. Description of field forms

There are 6 different forms of one or more pages, as indicated in the table below.

Table12. Field forms description and corresponding information level

Form No.	Information (see figures in Annex 6.9,)	Number/SU
F1 cover/ a/b/c/ (d/e/...)	**Sampling unit (SU)**: - **F1 Cover** – Field inventory summary (number of forms, problems encountered) - **F1a** -General information and SU access - **F1b** - List of persons involved in the inventory - F1c - **F1d** – Fauna in SU (wildlife observations...)	1 of each
F2	**Plot**: Marker position, plot access and plan	4
F3a/b	**Plot and RSP**: Tree and stumps measurements (Dbh ≥10 cm)	≥4 *(at least one per plot)*
F4a/b/c/d	**Subplots, fallen deadwood transect and measurement points**: - **F4a**: Topography, soil, litter and land use /cover area - **F4b**: Small tree measurements within CSP (Dbh < 10 cm); - **F4c**: Shrubs/Bushes measurements; - **F4d**: Indicator plant species, fallen deadwood transect.	≥4 of each *(at least one of each per plot)*
F5	**Land Use/Cover Section (LUCS)**: - General information (land tenure, vegetation cover, environmental, problems) - Forest and other woodland structure and management - Crop management practices	≥4 *(at least one per plot, one for each LUCS)*
F6a/b F6a/b (p)	**Land Use/Cover class** (**LUCC**): Products and services and users (forest and trees, wildlife and crop and fish) – Threaten and extinct species – Invasive species - Land use changes	≥1 *(at least one **F6a** for each LUCC)*

The data to be recorded in the field forms as follows:

- [box] .... or ➲ Free text;
- [box] C ➲ **Numeric codes** to be recorded in the box; the option codes are given below in the field forms description;
- [box] Y/N ➲ **Y or N** respectively for "Yes" or "No" to be recorded in the box;
- [grey box] ➲ **Checkbox**, to be marked, when the box or table cell is dark grey;
- [box] _ _, _ km or [box] m ➲ **Number** in the specified units (km, meters, m...).
- **The code "90"** is usually used for "unknown".
- **The code "99"** stands for other. When used, then it should be specified in the notes what "other" means together with the variable code (e.g. "variable 509b- 99= new legislation).
- **All tables and field forms must be compiled**. If some of them are not applicable then this as to be specified (either by indicating the "*not applicable*" code or by writing "n.a.". If there is nothing to be measured then indicate it on the form/table (eg: for F3 "*No trees to be measured in the plot*").
- **Pertinent notes** should be provided as much as possible, to help in understanding the data, indicate particularities, problems encountered by the field team, etc. If the space is insufficient then notes can be written on the backside of the form or on a blank page where the SU number will be also mentioned.

5.1   Form F1: Sampling unit (SU)

This form will be filled for each sampling unit (1 km x 1 km). It is divided into two or more parts: **F1 cover**, **F1a, F1b, F1c, (F1d), (F1e)**... It contains:

- **F1 cover**: summary notes of the work carried out in the sampling unit, stressing out the difficulties and problems that have been encountered.
- **F1a**: general information related to the sampling unit (SU) location, access and identification, information on the people living within and in the surrounding area of the SU and on the distance to the main infrastructures.
- **F1c**: list of households within the SU.
- **(F1d):** information about use, pressure and contamination of the different types of water points (F1b) and catchment conditions.
- **(F1e)**: Other relevant forms for information to be collected at SU level (wildlife observations,...).

Headline: identification of the SU

- **Country name (1).**
- **SU Nº (2)**: identification number of the sampling unit (from 1 to total SU number). See map with sampling units (see Figure 1).

Cover page (Form F1 cover): number of forms and descriptive notes of the SU

- **Start date (33d):** date (dd/mm/yy) when accessing the SU by vehicle (from previous SU or a base).
- **End date (33e)**: date (dd/mm/yy) when leaving the SU.
- **Leaving for SU No (33f):** identification number of the next surveyed SU (from 1 to total SU number). If the team leaves for a base and not another SU, then nothing should be written.

  Leaving for base (33g): checkbox, indicating that the field team will go next to a base (home town or other) and not to another SU.

- **Forms numbers:** total number of forms compiled in the SU. In parenthesis, are the possible ranges for each form.
- **LUCC number (80d):** total number of land use/cover classes (LUCC) found in the SU (inside the plots).
- **Descriptive notes (38):** these notes summarize any particularities encountered of the sampling unit (vegetation, terrain, local population, logistics...). Also, the NFMA is a long term process that will involve revisiting of all or selected sampling units after a few years. Therefore, it is important for the initial field teams to provide a detailed description of the difficulties encountered during the work, as well as the strategy used <u>and recommendations</u> on how to solve them. The remarks are provided for:

  Organisation and site description (38c): logistics during the inventory, access to the SU, landscape composition and dynamics;

  Field measurements (38d): terrain, vegetation types, measurements constraints and particularities;

  Interviews and contact with populations (38e): including with interviewees, local guides, authorities, owners and local institutions.

A.   SU location (Form F1a): general information on SU location.

- **(ADM1) (7):** name of the first administrative division level (e.g. state) where the SU is located.
- **(ADM2) (8):** name of the second administrative division level (e.g. province) where the SU is located.
- **(ADM3) (9)**: name of the third administrative division level (e.g. district) where the SU is located.
- **(ADM4) (10):** name of the fourth administrative division level (e.g. locality, etc.) where the SU is located.
- **(ADM5) (10b):** other administrative division level (e.g. municipality, etc.).

F1

- **Global Ecological Zone (GEZ) (11a):** name of the global ecological zone where the SU is located, based on the FRA Global Ecological Zones map. The various classes are as follows:

Options	Description/definition	Code
Subtropical humid forest		SCf
Subtropical dry forest		SCs
Subtropical steppe		SBSh
Subtropical desert		SBWh
Subtropical mountain		SM

National/Regional ecological zone (11b): name of the national or regional ecological zones where the SU is located. To be indicated according to option list:

Options	Description/definition	Code
The desert	The annual rainfall is below 75mm. The vegetation is virtually absent except along water courses represented by Fagonia cretica , Indigofera oblongifolia and Aerva javonica . Ephemerals and herbs appear after the rare rain showers.	1
The semi desert	The rainfall varies from about 75- 300mm, very variable and unreliable. The vegetation is a variable mixture of grasses and herbs with a variable scatter of low shrubs and bushes interspersed with bare areas. The belt is represented by various vegetation formations according to changes in rainfall and soils. Acacia toritllis and Maerua crassifolia in the eastern clay plains, Acacia mellifera and Commiphora africana in the sandy soil of the west.	2
Woodland savannah	It is a mixture of vegetation types composed of grasses, shrubs and trees thriving under annual rainfall between 300 to over 1500 mm. In view of the wide range of rainfall and soil variation, the woodland savannah is sub divided into a) low rainfall savannah and b) high rainfall savannah. The latter is confined to small areas in south of Talodi and south of um Dafoug in south Darfur, and southwards to cover the entire South represented by the Vuba belt in Bahr el Ghazal and in Equatoria. The boundary between the two types lies between the isohyets 800-1000 mm..	3
The Flood Region	These are the swamps flooded by the White Nile and inland khors . The region is the most important Sudan's wet lands, covers most of Upper Nile and parts in quatoria and Bahr el Ghazal. The tree vegetation is similar to that in the low rainfall savannah, confined to termite mounds and elevated ground in the peripheries.	4

F1

Montane Vegetation	The vegetation on the four mountain masses has very little in common except that it differs from the surrounding areas because of the effect of altitude and the higher rainfall. In Equatoria, the lower slopes of the Imatong and Dongotona below 1500m.carry a vegetation similar to that of woodland recently derived from rain forest. The climax vegetation between 1500- 2600 m. is represented by Syzgium gerrardii, Olea hochstetteri and Podocarpus milanjianus. The latter species forms the climax above 2600- 3000 m. The Didinga mountain is similar to the low mountain zone of the Imatong, with a mixed forest of Podocarpus and Juniperus procera. On the Red Sea Hills, the vegetation is composed of Juniperus procera, Olea chrysophylla, Pittosporum viridifolium and Maba abyssinica . Jebel Marra is largely cultivated, among which are species of Cordia africana, Azanza garkeana and Ficus gnaphalocarpus.	5

Figure 15: Map of the ecological zones of Sudan (Harisson & Jakson)

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F1
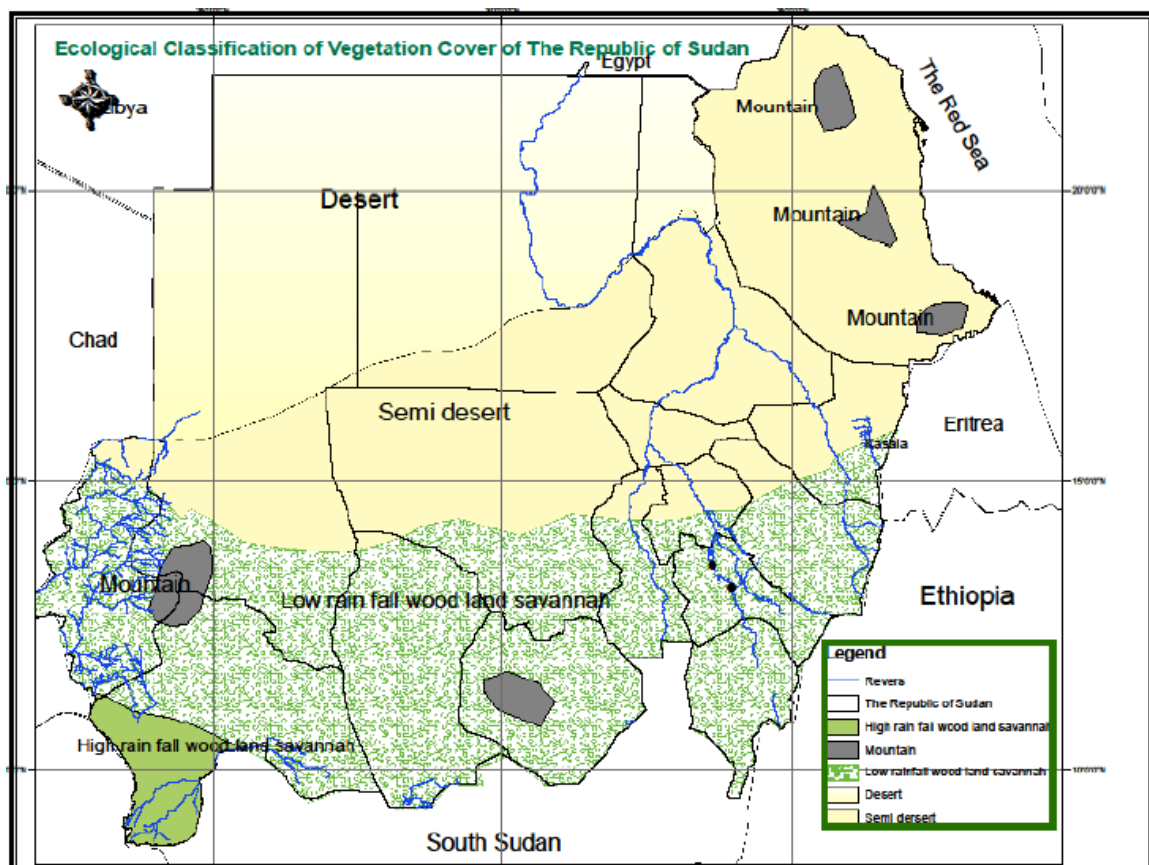
- **Altitude (12):** altitude in meters above the sea level of the central point of the SU. May be determined from a topographic map or from GPS as the average of the altitude at each plot starting point.
- **Maps and aerial photos (13):** name of maps (reference code, date) and aerial photographs or satellite images (acquisition date, coordinates) used for the location of the SU.
- **Coordinates SU SW corner (14):** calculated coordinates latitude (**14a**) and longitude (**14b**) in decimal degrees, and in easting (**14d**) and northing (**14e**) in meters in the projection system of the south-western corner of the SU.
- **Coordinate system (14c):** projected coordinated system used for the inventory (for GPS reading). To be selected by marking the appropriate checkbox (if there are several projection zones e.g. UTM 36N, 36S, 37N or 37S).

B. Human population (Form F1a)

Sedentary population distribution:

- **Number of households (21c):** estimate of the total number of sedentary households in the SU (or HSA-2 km radius circle of SU centre, in ILUA). Total number and percentage of female headed households (= "F") and male headed households (= "M").
- **Average household size (21f):** average size (number of persons) of households in the SU (or HSA in ILUA), calculated for total households, female headed (= "F") and male headed (= "M") households. If the information is not known then write "nk" (=unknown).
- **Population on the SU (21):** estimate of the total number of people living in the SU. Total number and distribution by gender in percent ("F"= female; "M"= male). If the information is not known then write "nk" (=unknown).
- **Adult literacy rate (21d):** refers to percentage of adult population, 15 years old and over, who are able to read and write, in total, female (F) and male (M) population. If the information is not known then write "nk" (=unknown).
- **Ethnic group (21e):** name of the main ethnic group found in the area of the SU. To be indicated according to an option list

Options	Description/definition	Code
Not applicable	No population living in the area	**0**
Nuba		**1**
Nubiyieen		**2**
Fallata/Fulani		**3**
Arab		**4**
Bija		**5**
African/Black		**6**
Mixture		**7**

- **Years since settlement (22):** approximate number of years since when the settlement was established in or close to the SU. This data could be collected from external or internal key informants and verified in the field though interviews and observations. To be indicated according to an option list:

Options	Description/definition	Code
Not applicable		**0**
< 5 years		**1**
5 – 10 years		**2**
10 – 20 years		**3**
20 - 50 years		**4**
>50 years		**5**
Not known		**90**

F1

Population dynamics (23): trend of the population living in or close to the SU, in the past 5 years. To be indicated according to an option list:

Options	Description/definition	Code
Not applicable	No inhabitants in the site or surroundings	0
Decreasing	The population living in the site decreased during the last 5 years	1
Stable	The number of people living in the site remained stable during the last 5 years	2
Increasing	The population living in the site increased during the last 5 years	3
Not known	There is not enough information to estimate this trend	90

Population main/secondary activity (24): main (**24a**) and secondary (**24b**) income generation and employment source of most of the population living within the SU or in the surroundings. The expression "income generation" refers to activities to satisfy basic needs such as food and housing, i.e. self-sufficient farmers or as workers in the town. To be indicated according to an option list:

Options	Description/definition	Code
Not applicable	No inhabitants in the SU or surroundings	0
Crop production	Livelihood and income generation provided by cropping activities	1
Livestock/ Herding	Livelihood and income generation provided by livestock, pasture, herding	2
Forestry	Livelihood and income generation provided by the forest and related activities, including processing and marketing of forest products	3
Aquaculture	Livelihood and income generation provided by aquaculture activities (fish farming, mariculture, algaculture)	4
Fishing	Livelihood and income generation provided by fishing	5
Industry	Work in the industrial sector	6
Handicraft	Livelihood and income generation provided by handicraft	7
Trade	Livelihood and income generation provided by trade in goods or services	8
Services	Income generated from services (doctor, lawyer, teacher...)	9
Tourism	Income generated from tourism or activities related to recreation	10
Mining / Extraction	Livelihood and income generation provided by mining and extraction activity	11
Hunting	Livelihood and income generation provided by hunting	12
Gathering	Livelihood and income generation provided by collecting fruits, plants, nuts, fibre from a wild area	13
Others	To be specified. Includes subsidies, etc.	

Nomadic and transhumant population: population that only stays within the SU or in the surrounding for a short period of time according to the seasons.

- **Number of households (21g):** estimate of the number of nomadic/transhumant households coming in the SU.
- **Average household size (21h):** average size (number of persons) of nomadic/transhumant households in the SU.

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- **Ethnic group (21i):** name of the main nomadic / transhumant population ethnic group found in the area of the SU**.** To be indicated according to an option list:

Options	Description/definition	Code
Not applicable	No population living in the area	0
Nuba		1
Nubiyieen		2
Fallata/Fulani		3
Arab		4
Bija		5
African/Black		6
Mixture		7

- **Period in the SU (21j):** period of time where the nomadic / transhumant population stays in the area of the SU expressed in starting month –end month (e.g. May to July = "05-07").

Settlement history (25): major historical events that have affected the local people and land use in the area, to be indicated by marking the appropriate checkbox(es) (multiple choice possible) and date or periods of these events **(25a)**:

Options	Description/definition	Code
Not applicable	No inhabitants in the SU or surroundings	0
Wars	Armed conflicts that obligate people to look for safer places to live	1
Insecurity, ethnic conflict	When people move from their original places looking for safety, major problems between ethic groups that force people to look for other places to live	2
Change of ownership/ land tenure	When a new owner forces the people to move from his property	3
Expansion of agriculture	Land converted to agriculture fields or pastures from other land use	4
Urban development	Land changed from agricultural production, open rangeland, forest, or recreational uses to residential, commercial, or industrial uses	5
Infrastructure, electric power	Infrastructure, e.g., roads, water or water channel, electric line, recently installed in the SU	6
Economic crisis	Drastic reduction in income generation, enterprises, changes in consumption patterns	7
Natural disaster	Severe drought, flood, landslide, etc.	8
Human diseases	Causing drastic change in labour force and dependency ratio	9
Rural-to-urban migration	Migration of people from rural areas to urban areas	10
Urban-to-rural migration	Migration of people from urban areas to rural areas	11
Rural-to-rural migration	Migration of people from a rural area to another	12
Urban-to-urban migration	Migration of people from a urban area to another	13
Immigration	There has been an influx of people from other countries moving to the area	14
Emigration	There has been an exodus of people from the area to other countries	15
Squatters	Land that is illegally owned by the owners but have been living there for many years	16
Others	To be specified	

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C. Proximity to infrastructure (Form F1a)

- **All-weather road (26):** distance, in km, to reach the closest all-weather road (accessible by motor vehicle all the year), departing from the SU centre (equal to 0 if the road is located within the SU).

- **Seasonal road (27):** distance, in km, from the centre of the SU to the closest seasonal road (road accessible by motor vehicle during some seasons only, equal to 0 if it is located within the SU).

- **Settlement (28):** distance, in km, from the SU centre to the closest settlement (village...) equal to 0 if it is located within the SU).

- **Health centre (29):** distance, in km, to reach the closest health centre (hospital, dispensary...), departing from the SU centre (equal to 0 if the hospital is located within the SU).

- **Veterinary services (29b):** distance, in km, to reach the closest veterinary services, departing from the SU centre (equal to 0 if the hospital is located within the SU).

- **School (30)**: distance, in km, to reach the closest school, departing from the SU centre (equal 0 if the school is located within the SU).

- **Food market place (31a):** distance, in km, to reach the closest food market (to satisfy domestic needs), departing from the SU centre (equal to 0 if the market is located within the SU).

- **Input market place (31b):** distance, in km, to reach the closest market where inputs can be bought (seeds, fertilizers, forestry tools…) (equal to 0 if the market is located within the SU).

D. Access to SU (Form F1a)

- **Starting position (32a and 32b/ 32c and 32d):** latitude (32a) and longitude (32b) in decimal degrees, or easting (**32d**) and northing (**32c**) coordinates, in meters (in the coordinate system adopted), of starting position where the field team starts accessing the SU by foot (i.e. at the closest road accessible by motor vehicle) as read on the GPS.

- **Access Time – Start date (33c) and time (33a):** date (dd/mm/yy) and time (hh:mm) when leaving vehicle to access the SU by foot.

- **Access Time – End date (34c) and time (34a)**: date (dd/mm/yy) and time (hh:mm) when arriving at the first plot.

- **Total access time (34d)**: total time spent for accessing the first surveyed plot, by foot (hh:mm).

- **Arriving at plot No (34b):** number of the first surveyed plot (from 1 to 4).

- Reference points of access path: these points will be used to retrieve the SU in the future. An itinerary sketch representing the access path from the road where the car is left to the SU will be drawn on reverse page (F1a/R) while accessing the SU and attached. It could be also drawn on the map attached to the SU report. The following data must be filled in for each SU (see example on Table 8):

- **ID (35):** reference point ID (number from 1 to a series of reference points); this number is reported on the attached itinerary scheme.

- **Description (36):** brief description of reference point (i.e. road, river, house, rock).

- **Projection Zone (37c)**: projection zone of the coordinates of the reference point, only if different from the one indicated in Section A and if there are different zones in the country (variable 14c).

- **X (37a) and Y (37b):** easting and northing coordinates for the reference point, in meters in the projection system adopted, given by GPS.

- **Photo N° (36b):** running number of the photo on the access path to SU from the coordinate given in **37a** and **37b** (from 1 to the total number of photos taken in the SU).

- **Bearing (36d):** compass bearing in which the photo is taken (from 0 to 360 degrees).

- **Notes (38a):** relevant notes concerning the SU including population in the area, historical events, particularities, access to the SU.

E. Team/Owner/Informant list (Form F1b)

This table will include name (15), address (16), title or function (16b) and telephone number (17) (if possible) of:

- **Team leader (18a):** the leader of the team in current SU. In this case, "team leader" will be ticked.

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- **Team members (18b):** other team members working in the SU. In this case, "team member" will be ticked.
- **Owner (19):** owner(s) of all, or part of the land where the SU is located. In this case, "owner" will be ticked.
- **Informant (20):** the persons interviewed in the SU referred by a code indicating existing relationship between the informant and the SU. To be indicated according to option list (multiple choice possible):

Options	Description/definition	Code
Owner	Owner of a plot or part of a plot within the SU	**O**
Employee	Person working in the SU	**E**
Manager of site	Person responsible for natural resources management in the SU	**M**
Settler	Person living in the SU or user from surroundings	**S**
Internal key informant	Individual living inside the area, with in-depth knowledge of the local settings, use of land and natural resources	**I**
External key informant	Individual living outside the area, but with particular knowledge about the site, the land/ natural resource use and the local community (e.g. local government officials, leaders of local organizations...)	**X**
Owner	Owner of a plot or part of a plot within the SU	**O**

- **Notes (38b):** relevant notes concerning to the persons involved in the assessment within the SU.

F. Other forms (Form F1d): e.g. wildlife observations

To be developed according to Sudan requirements.

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5.2 Form F2: Plot

This form will be filled in for each plot contained in the sampling unit (thus, a total of 4 per SU). The forms will include the general data on the plot and the information on its location and access.

Plot identification

- **Country name (1)**
- **SU Nº (2):** identification number of the sampling unit (from 1 to total SU number). See map with SUs (see Figure 1).
- **Plot Nº (3):** identification number of the plot (1 to 4).

A. Plot access

This section is not completed for the first visited plot in the SU as the information was already registered in section D of Field form **F1a**.

- **Starting position (34):** easting (**34g**) and northing (**34h**) coordinates where the field team starts accessing the plot by foot (at the closest road accessible by motor vehicle or from the previous surveyed plot), in meters, in the projection system adopted (GPS reading).
- **Access time - Start time (34i):** time when the field team starts accessing the plot by foot (hh: mm).
- **Access time - End time (34j)**: time when arriving at the plot (hh: mm).

B. Time record of work within Plot

- **Date 1 (48):** first date of measurement in the plot (dd/mm/yy).
- **Date 2 (50):** second date of measurement if the work in the plot cannot be completed within one day (day / month / year).
- **Start time (49):** start time of measurement in the plot (hh:mm) at the first **(49a)** or second **(49b)** measurement day. The measurements start when the permanent marker has been driven in the ground.
- **End time (51):** end time of measurement in the plot (hh:mm) at the first **(50a)** or second **(51b)** measurement day.

C. Plot starting point description

This part contains the indications to identify the plot starting point and the marker location:

Plot starting point (given):

- **X (39a)** and **Y (39b):** easting and northing coordinates of the plot starting point, in meters, in the projection system adopted. These coordinates are given to the teams (theoretical).

Marker position (GPS reading):

- **X (40a)** and **Y (40b):** easting and northing coordinates of the marker, in meters, in the projection system adopted, as read on the GPS. The "average" function of the GPS will be used for more accuracy.
- **Distance from Marker to Plot starting point (41):** distance in meters from the plot starting point to the marker (equal to "0" if the marker and the starting point coincide).
- **Bearing from Marker to Plot starting point (42):** compass bearing (from 0 to 360 degrees) from marker to the plot starting point (equal to "n.a." if the marker and the plot starting point coincide).

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- **Plot starting point plan (43):** three accurate and if possible permanent reference points such as rock, house, bridge, dominant/outstanding trees must be selected in order to be able to find the marker in the future. The orientation and distance of three reference points, from the marker should be measured. The three bearings should preferably be as different as possible and not in alignment. These reference points as well as the plot start position will be represented in the plan (Establishment of permanent plot). Information and measurements concerning the reference points will also be reported into a table as following:

- **ID (44):** identification of the reference points (e.g. R1).

- **Description (45):** description of the reference points (e.g. north side of rock, Pinus with Dbh= 95 cm).

- **Bearing (46):** orientation of the reference points from the marker, in degrees.

- **Distance (47):** distance of the reference points to the marker, in meters.

A recommendable supplement to the registration of reference points could be to photograph each reference point from the marker position **(36c)**.

- **Photo Nº (36c):** running photo number within the UE from the marker (from 1 to the total number of photos taken in the UE).

D. Plot plan (52): Scheme displaying plot layout

Figure16 . Plot plan example

The scheme represents the plot as a whole. The rectangular and the circular subplots are both drawn in the scheme. The starting point is located at the bottom of the page. The central axis of the plot (X axis) at 0 m on the vertical axis (Y axis) and the locations of circular and rectangular subplots centres (located on the main axis, at 5 m, 125 m and 245 m) are included.

The following objects should be drawn (see example in Figure):

- **Borderlines of the LUCS**, including the code of the land use/cover classes inside the corresponding sections, see

- Figure 3.

- **Intersections with infrastructure** (roads, paths…) **and water courses**, as line object, including the code and width of the road/water course. The line drawing corresponds to the centre of the road/stream.

Codes must be attached to the lines according to the legend included in the form (water course, road type). The total **number of water courses and roads crossing the plot** should be indicated in the field **52b,** once the plot survey is completed.

In addition, the sketch must also include all the information and observations that help interpreting the plot. When entering the fieldwork data in the database these notes must be entered in the field **52a** plot plan notes in the database.

- **Plot middle point (39c and 39d):** easting (**39c**) and northing (**39d**) coordinates of the plot middle point (at 125 m from plot starting point), in meters, in the projection system adopted (GPS reading).

- **Plot end point (39e and 39f):** easting (**39e**) and northing (**39f**) coordinates of the plot end point (at 250 m from plot starting point) in meters, in the projection system adopted (GPS reading).

- **Notes (53):** relevant notes concerning the whole plot, on access, vegetation, marker (if the markers could not be put it should be explain why), problems and difficulties encountered during the survey in the plot.

F2
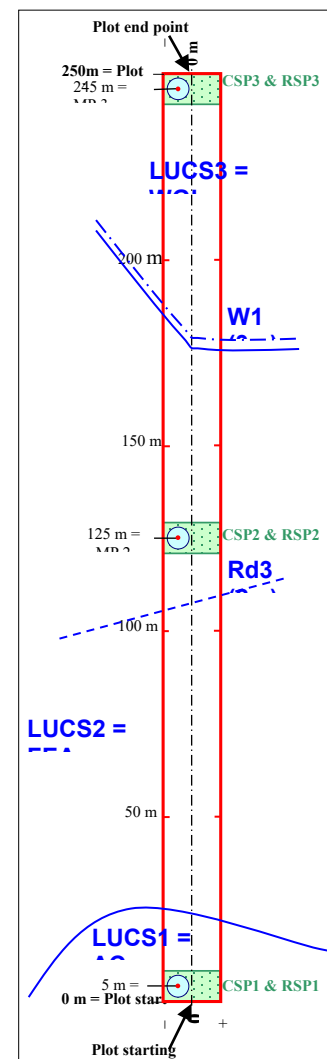
5.3 Form F3: Plot - Tree and stump measurements

This form consists of a table where information related to all the trees and stumps measured in the plots will be recorded, apart from tree regeneration (height over 1.3m), whose data, collected in the Circular Subplot, will be reported in the form F4 (see Table).

The form **F3a** will be used for most of the trees. If branches represent most of the volume in a tree then the form **F3b** will be used for that tree.

Plot identification

- **Country name (1)**
- **SU Nº (2):** identification number of the SU (from 1 to total SU number). See map with SUs.
- **Plot Nº (3):** identification number of the plot (1 to 4):

Table: this table will contain data related to:

- ✓ All trees and stumps with Dbh ≥ 20 cm present in the plot (in forest Land Use/Cover Sections) and Dbh ≥ 10 cm in all non forest sections;
- ✓ Trees and stumps with a Dbh ≥ 10 cm measured in rectangular subplots (in forest Land Use/Cover Sections);
- **LUCS No (4a):** identification number (from 1 to number of land use/cover sections within the plot) of the LUCS where the tree/stump is found.
- **Tree No (55):** tree/stump identification number. Trees are numbered consecutively in the order they are measured.
- **Stump (55b):** indicate if the measurement is for a stump (checkbox).
- **Species (56):** either common/local **(56a)** or scientific **(56b)** species name of the tree. In the case of local name, the language used should be specified into brackets.
- **Tree/Stump location:** tree or stump location in plot:
- **Along plot axis (57a):** horizontal distance in meters along the plot axis from plot starting point to the tree (from 0 to 250 m).
- **Left or right axis (57b):** horizontal distance in meters from the plot central axis to the tree (from 0 to 10 m).
- **Dbh (58):** tree or stump diameter, in centimetres:
- In the case of a tree, diameter in centimetres at breast height (1.3 m, Dbh) (see appendix section 6.2.1 for diameter measurements and particular cases).
- In the case of a stump, the stump diameter, in centimetres, at breast height (Dbh) or measured at the top of the stump (stump height) if the stump is lower than 1.3 m (Dsh).
- **Diameter height (59):** height of diameter measurement in meters, if different from breast height (1.3 m, Dbh).
- **Year(s) since cut (60):** only for stumps. Estimated time since the tree was cut according to option list:

Options	Description/definition	Code
< 1 year	Recent exploitation	**1**
1 – 5 years	The harvest took place between 1-5 years	**2**
6 – 10 years	The harvest took place between 6-10 years	**3**
> 10 years	The harvest took place more than 10 years ago	**4**
Not known	There is not enough information to know about the year since cut	**90**

- **Total height (61):** total tree or stump height in meters (see appendix section 1.1)
- **Bole height (62):** tree height at the first big branch in meters (only for trees).

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- **Stem quality (63):** estimated stem quality (only for trees). To be indicated according to option list:

Options	Description/definition	Code
Low	Tree with several defects or damage due to fire, pests, diseases, animals...	1
Medium	Tree with little defects or damage due to fire, pests, diseases, animals, etc.	2
High	Straight tree without visible damage due to fire, pests, diseases, animals, etc	3

Health (*does not apply to stumps*):

- **Crown condition (64b):** intensity of the symptom. To be indicated according to option list:

Options	Description/definition	Code
Healthy	Crown transparency less than 50%, no top dieback	1
Declining health	Crown transparency approximately 50%, top dieback evident	2
Unhealthy	Crown transparency more than 50% and significant top dieback	3
Dying	Crown transparency more than 75%, increased dieback	4
Dead	Trees apparently killed in earlier growing season	5

- **Overall tree condition (64):** intensity of the symptom. To be indicated according to option list:

Options	Description/definition	Code
Healthy	A tree is healthy when it does not show symptoms of disease or other that have any substantial effect on the tree's growth and vitality	1
Slightly affected	A tree is slightly affected when it shows symptoms of disease or other that to some extent affect the tree's growth and vitality	2
Severely affected	A tree is severely affected when it shows symptoms of disease or other that substantially affect the tree's growth and vitality without being lethal	3
Dead/Dying standing tree	A tree is dead when none of its parts are alive (leaves, buds, cambium) at 1.3m or above. A tree is dying if it shows damage that will surely lead to death. Standing	4
Dead/Dying fallen tree	A tree is dead when none of its parts are alive (leaves, bud, cambium) at 1.3m or above. Diameter of a fallen tree is measured at the estimated previous breast height. A tree is dying if it has damage that will surely lead to death. Fallen	5

F3

- **Causative agents (65):** causative agents that have been identified (diseases, insects, animals, etc.), according to option list (multiple choice possible):

Options	Description/definition	Code
Not applicable	Healthy tree crown, with no symptoms of insects, disease or any stress including parasitic plants	0
Insects	Evidence of insect infestation (e.g. defoliation, leaf feeding)	1
Disease/Fungi	Presence of fungus such as leaf spots, leaf or needle discolouration	2
Fires	Burned	3
Animals	Damage due to wild or domestic animals	4
Humans	Human induced damage (cuttings, bark damage, logging...)	5
Climate	Damage caused by extreme climatic events (wind, snow, lightning, etc.) e.g. broken branches	6
Other	To be specified in the notes	99

- **Decomposition status (64c):** only for dead trees, degree of decomposition of the tree. To be indicated according to option list:

Options	Description/definition	Code
Branches and twigs	A dead tree with branches and twigs, resembling to a live tree	1
Small and large branches	A dead tree with no twig, but with persistent small and large branches	2
Large branches	A dead tree with large branches only	3
"Intact" Bole	A dead tree with the bole (trunk) only, without branches. The bole wood is almost intact, with low decomposition	4
Rotten Bole	A dead tree with the bole (trunk) only, without branches. The bole is rotten, with advanced decomposition	5

Branches (F3b): up to four major branches (minimum diameter ≥ 20 cm and length ≥ 2 m) per tree should be measured if the branches represent a relatively large proportion of the tree woody volume.

- **D1, D2, D3, D4 (66a-d):** mean diameter, in centimetres, of the four measured part of branches.
- **L1, L2, L3 L4 (67a-d**): length, in meters, of the four measured branches.
- **Tree Notes (68):** relevant notes concerning the trees and stumps, problems of species identification, particular trees or general health condition of trees.

5.4 Form F4: Subplots and measurement points

This form (see Annex 6.9) contains the information on tree regeneration and plant indicator species on the circular subplots (CSP), shrub measurements on Rectangular Subplots (RSP), as well as on edaphic and topographic variables from the measurement points (MP).

Plot identification

- **Country name (1)**.
- **SU Nº (2):** identification number of the SU (from 1 to total SU number).
- **Plot Nº (3):** identification number of the plot (1 to 4).

A. Measurement points: topography and soil (F4a)

Variables on topography and soil are collected in three fixed measurement points located in the centre of each subplot (measurement points).

The information is recorded in three boxes corresponding to the three measurement points. These include:

- **LUCS Nº** (4b): identification number (from 1 to number of land use/cover sections) of the LUCS where the measurement point is located.

Site information:

- **Slope (71):** the average inclination at the measurement point. To be indicated in **%.** The angle of slope is measured from the measurement point to a point at 20 m horizontal distance along the direction of the highest slope. If the slope is not homogeneous then the slope is an average of the up and down slope readings from the measurement point**.**
- **Slope orientation (70):** slope direction at measurement point. To be indicated as compass bearing (from 0 to 360º). On flat terrain write "n.a." (not applicable).
- **Relief (72):** topography of subplots. Characterized by the position in the landscape, the landform and micro-relief. To be indicated according to option list:

Options	Description/definition	Code
Plateau	Relatively flat (slope ≤ 5%); terrain of great extent and high elevation, above adjacent lowlands limited by an abrupt descent scarp on at least one side. May be dissected by deep valleys and deeply incised rivers	**1**
Summit / Crest	Crest of any kind or hilltop; can be sharp or rounded	**2**
Upper slope	Upper slope of hillside (located on the upper 1/3 of the slope) (shoulder)	**3**
Middle slope	Middle slope of hillside (slope > 5 %) (back slope)	**4**
Lower slope	Lower slope of hillside (foot slope)	**5**
Bench / Terrace	Horizontal zone of average width over 30 m interposed in the valley side (slope < 15%) or a terrace over 6 m width	**6**
Valley	Very wide, gently sloping depression with predominant extent in one direction commonly situated between two mountains or ranges of hills. The profile may be U-or V-shaped. Includes river valley (formed by flowing water) or glacier valleys	**7**
Plain	A large flat to very gently undulating area at a low elevation with reference to surroundings	**8**
Narrow depression	Enclosed depression or small, narrow valley or distinct crater (including ravine, gorges, gullies, canyons...)	**9**
Water course	Permanent or temporary water course (river...)	**10**

Dunes	Sandy hills developed through sand deposits from wind erosion/storms, often unstable and moving	11
Other	To be indicated in teh notes	99

- **ID Photo (72b):** running photo numbers within the SU, taken from the measurement point (from 1 to the total number of photos taken inside the SU), of one or more photographs of the landscape taken at the MP location and representing the site.
- **Photo bearing (72c):** compass bearing in which the photo is taken (from 0 to 360 degrees).

Soil information:

The biophysical and hydrological properties of the soil are assessed at the measurement points using observations and/ or the rapid Soil Visual Assessment technique (VS-Fast,).

- **Organic layer thickness (75):** the thickness of organic layer (or "O" horizon) measured, in centimetres, from the soil surface using a measuring tape or ruler or a stick graduated in centimetres. This layer is dark-coloured dominated by organic material consisting of undecomposed or partially decomposed litter such as leaves, dead grasses, needles, twigs, bark, moss and lichens, that has accumulated on the surface.
- **Soil drainage (74)**: average soil drainage reflected by the time water remains on the surface after a heavy rainfall and resulting waterlogging. This is indicated by the number and colour of orange or grey mottles (spots, patches of different colour) in the soil and degree of soil compaction. Mottles are observed on the side of the soil profile or on and in a few soil clods from the extracted soil block. To be described according to option list:

Options	Description/definition	Code
No drainage	Land covered with water most of the year, such as lakes, swamps and mangroves, etc.	0
Poor drainage	Significant surface ponding (lying water) for several months. Soil has abundant medium and coarse orange and particularly grey mottles	1
Moderate drainage	Water/humidity may stay in the soil for several weeks. Soil has some (10-25%) fine and medium orange and grey mottles	2
Good drainage	No evidence of surface ponding after one day following heavy rain, however, water/ humidity may stay in the soil for several consecutive days. Mottles are generally absent	3
Very good drainage	No surface ponding. Moisture/water does not stay in the soil during more than a few consecutive hours. E.g. sandy soils will dry out rapidly. Mottles are absent	4

B. Litter Subplot (LSP) - Litter layer

Variables on litter are collected in the three Litter Subplots (LSP). The information is recorded in three boxes corresponding to the three LSP. These include:

- **LUCS Nº (4i):** identification number (from 1 to number of land use/cover sections) of the LUCS where the measurement point is located.
- **Litter depth (801):** average depth, in cm, of the litter layer in the Litter Subplot, measured from the soil surface using a measuring tape or ruler. This layer is dominated by non-living woody and non woody biomass in particular twigs, small branches with a diameter less than 2.5 cm, dead leaves and dead grasses.

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- **Litter composition** (**802**): main elements forming the litter. To be described according to option list:

Options	Description/definition	Code
Woody	Includes twigs, small branches...	1
Non woody	Includes leaves, dead herbs and grasses, seeds and fruits	2

- **Notes (79a):** relevant notes concerning the litter in the LSP and measurements points.

C. Land use/cover area in subplots (F4a)

This section contains 3 tables used to record land use/cover area in circular and rectangular subplots. One table must be filled for each group of subplots (subplots 1, 2 and 3).

- **LUCS No (4c/d/e):** identification number (from 1 to number of LUCS within the plot) of the LUCS found in the subplot. It can be up to two different LUCS covering each CSP and up to three different LUCS in each RSP. The number should correspond to the one given in F5 form.
- **Area % (54c/d/e):** percentage of the subplot area covered by the LUCS (1 to 100%).

D. Circular Subplots – Small trees measurements (trees above 1.3 m height with Dbh <10 cm) (F4b)

This section must be filled for the circular subplots (CSP) to count small trees, above 1.3m height and with Dbh <10cm (see also section 4.4.2D2).

Each line of the table corresponds to one species found in any of the CSP. In the columns the tree species name and the corresponding number of individual found in each subplot are registered.

- **Species (77):** either common/local **(77a)** or scientific **(77b)** species name of the tree.
- **LUCS No (4g):** identification number (from 1 to number of land use/cover sections within the plot) of the LUCS where the trees are measured.
- **Counts (78a):** allows to count individual trees equal to or more than 1.3 m with a Dbh < 10 cm, per species, present in each Circular Subplot;
- **Total (78):** total number (sum of counts) of individual trees over 1.3 m with a Dbh < 10 cm, per species, present in each Circular Subplot.
- **Notes (79b):** relevant notes concerning small trees measured in CSP.

E. Rectangular subplots –Shrubs/Bushes measurements (optional) (F4d)

- **RSP No (6):** identification number of the Rectangular Subplot where the shrub/bush is found (from 1 to 3).
- **LUCS No (4h):** identification number (from 1 to number of land use/cover sections within the plot) of the LUCS where the shrub/bush is found.
- **Species (56):** either common/local (**56a**) or scientific (**56b**) species name of the shrub/bush. In the case of local name, the language used should be specified into brackets.
- **No of stems/unit (58b):** the number of stems in the shrub/bush.
- **Average stem $D_{0.5}h$ (58):** the average diameter of the stems, in centimetres, measured at 0.5 meters height.
- **Diameter measurement height (59):** height of diameter measurement in meters, if different from 0.5 m.
- **Average height (61):** average height of the stems, in meters.
- **Notes (79c):** all relevant notes concerning shrubs/bushes measured in RSP.

F. Rectangular Subplot (RSP) –Indicator plant species (optional) (F4d)

This section must be filled for each rectangular subplot (RSP) except if it falls into a Land Use/Cover Section classified as "water" or "annual crop lands".

Each line of the table corresponds to one indicator **plant** species found in any of the RSP. Information might be provided by informants (local guide). In the columns the species name and the corresponding number of

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individual found in each subplot are registered.

- **Common/ local or scientific species name (300):** either common/local **(300a)** or scientific **(300b)** name of the indicator plant species. If a local name is used then specified between brackets the language.
- **Indicator (301a):** type of indicator. To be described according to option list (multiple choice possible):

Options	Description/definition	Code
Range land condition	The plant species is an indicator of range land condition	**1**
Crop land condition	The plant species is an indicator of crop land condition	**2**
Forest condition	The plant species is an indicator of forest condition	**3**
Salinity / Sodicity	The plant species is an indicator of salinity or sodicity condition	**4**
Other	To be specified in the notes	**99**

- **Quality (301b):** states if the plant indicates poor or good conditions. To be indicated according to option list:

Options	Description/definition	Code
Not applicable	The plant indicate parameter useful for land management but not related to poor/good conditions	**0**
Poor conditions	The plant indicate poor conditions	**1**
Good conditions	The plant indicate good conditions	**2**

- **LUCS No (4f):** identification number (from 1 to number of land use/cover sections within the plot) of the LUCS where the plant indicator is found, for each Rectangular Subplot where the plant is identified. Up to three different LUCS can be specified (multiple choice).
- **Abundance (302):** quantity of plant found in the subplot. To be indicated according to option list:

Options	Description/definition	Code
Low	The plant is rare	**1**
Medium	The plant is common but not abundant	**2**
High	The plant is abundant	**3**

G. Fallen Deadwood Transect (FDT) – Dead branches (F4d)

This section must be filled for each Fallen Deadwood Transect (FDT). It contains a table where data on the dead logs and branches with a diameter equal or above 2.5 cm intersecting the transect line are recorded (see section 4.4.2D3).

- **LUCS No (4j):** identification number (from 1 to number of land use/cover sections within the plot) of the LUCS where the branch is measured.
- **Diameter (811):** the diameter of the branch, in centimetres, measured at the intersection point with the transect. If the log or branch is hollow, have gaps or is eroded estimates then estimates the diameter by removing the gap diameter.
- **Decomposition status (812):** degree of decomposition of the dead branch. To be indicated according to option list:

Options	Description/definition	Code
Sound		**1**
Rotten	The branch is crumbly,	**2**

- **Notes (79d):** relevant notes concerning dead branches measured along the FDT and indicator plant species.

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5.5   Form F5: Land Use/Cover Section (LUCS)

Information on Land use/cover section (LUCS) found in a given Plot will be registered on this. It contains general data related to the LUCS as well as data on forest structure and management and on agriculture management and products. One form is used to record information on each LUCS.

Plot identification

- **Country name (1)**.
- **SU Nº (2):** identification number of the sampling unit (from 1 to total SU number).
- **Plot Nº (3):** identification number of the plot (1 to 4).
- **LUCS number (4)**: identification number of the LUCS, from 1 to the number of LUCS identified in the plot.

A.   General

This section should be filled out for all LUCS.

- **Land use/cover class (80)**: code describing the land use/cover class (LUCC) in the LUCS, according to classification described in section. In case of inaccessible areas where the LU class cannot be specified, write "90" (="not know") in the box.
- **Accessibility (81c):** Condition of accessibility of the LUCS. To be indicated according to option list:

Options	Description/definition	Code
Accessible	Where topographic and road network makes it easy to access or reach the site	0
Inaccessible due to slope	Very steep slope making the field work dangerous	1
Inaccessible due to owner refusal	Where the owner does not allow one to enter the site either by fencing or by not giving permission	2
Inaccessible due to restricted area	E.g. military areas, border areas, land mines areas	3
Inaccessible due to water body	Where a water body does not allow to sample	4
Other inaccessibility	To be specified in the notes	99

- **Width (81a):** average width of the LUCS in meters.
- **Length (81b):** average length of the LUCS in meters.
- **Designation / Protection status (82)**: protection status and legal/official designation. To be indicated according to option list:

Options		Description/definition	Code
Protection / conservation	Strict nature reserve/ Wilderness area	Strictly protected area, managed mainly for science or wilderness protection. Corresponds to IUCN category I (see Annex section 6.8)	1
	National Park	Protected area managed mainly for ecosystem protection and recreation. Corresponds to IUCN category II (see Annex section 6.8). Includes National Parks	2
	Natural monument	Protected area managed mainly for conservation of specific natural features. Corresponds to IUCN category III (see Annex section 6.8). Includes National Heritage Sites	3
	Habitat/ species management area	Conservation through active management - Protected area managed mainly for conservation through management intervention. Corresponds to IUCN category IV (see Annex section 6.8)	4
	Protected landscape / seascape	Protected areas managed mainly for landscape/seascape conservation and recreation. Corresponds to IUCN category V (see Annex section 6.8)	5
Production		Land designated primarily for production and extraction of products	6
Social services		Land area designated primarily for social services such as recreation, tourism, education, research and cultural/ spiritual sites	7
Multiple use		Land designated to more than one purpose (production, protection and social functions) and where none of these alone is considered as the predominant designated function. Encompasses IUCN category VI (see Annex section 6.8)	8
Not known		No information available	90
Other		To be specified in the notes	99

Land tenure:

- **Land ownership (83):** land ownership designation under which most of the LUCS is defined. To be indicated according to option list:

Options		Description/definition	Code
Private	Individual	Land owned by individuals and families	1
	Industries	Land owned by private enterprises or industries	2
	Local communities	Land owned by a group of individuals belonging to the same community residing within or in the vicinity of the area. The community members are co-owners that share exclusive rights and duties, and benefits contribute to the community development	3
	Others private	Land owned by private co-operatives, corporations, religious and educational institutions, pension or investment funds, NGOs, nature conservation associations and other private institutions (religious, educational, etc.)	4
Public	State	Land owned by central government, or by government-owned institutions or corporations	5
	Local government	Land owned by local government (district, municipalities)	6

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Indigenous / Tribal communities	Land owned by community of indigenous or tribal people	7
Not known	No information available on the land ownership	90
Other	To be specified. Also includes areas where ownership is unclear or disputed.	

- **Management agreement (93a):** management arrangement between the land owner and other groups. To be indicated according to option list:

Options		Description/definition	Code
Owner is the exclusive manager		The owner retains management rights and responsibilities within the limits specified by the legislation	1
Joint management	with communities	Management decisions remain with the owner and the management activities are executed by local communities (including indigenous and tribal communities), according to an agreement. The agreement allocates temporary exploitation rights for specific products or activities. Are included lands allocated for extraction purposes through licenses or concession	2
Joint management	with private companies/ private sector	Management decisions remain with the owner and the management activities are executed by private companies, according to an agreement. The agreement allocates temporary exploitation rights for specific products or activities. Are included lands allocated for extraction purposes through license or concession	3
Devolution of management rights	to communities	The owner devolves land management to the local communities (including indigenous and tribal communities) according to leases or management agreement	4
Devolution of management rights	to private companies/ private sector	The owner devolves land management to the private companies/private sector/individuals according to leases or management agreement, including rental	5
Not known		There is not enough information to obtain management agreement	90
Other		To be specified in notes	99

Vegetation cover:

- **Tree Canopy cover (92):** ground surface covered by the vertical projection of the tree canopies, expressed as percentage of the total ground area in the LUCS. To be indicated according to option list:

Options	Description/definition	Code
No trees		0
< 5%	Very few trees	1
5-10%	Sparse tree canopy cover	2
10-40%	Very open tree canopy cover	3
40-70%	Open tree canopy cover	4
>70%	Closed tree canopy cover	5

- **TOF distribution (92g):** spatial distribution of trees outside forest (TOF). To be indicated according to option list:

Options	Description/definition	Code
Not applicable	Forest LUCS or no tree	0
Scattered	TOF are sparse	1
Grouped	TOF are grouped in blocks	2

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Lines	TOF are aligned (e.g. fences, roadside plantations...)	3
Other	To be indicated in the notes	99

- **Trees expected (88):** Trend in tree density expected in LUCS within 5 years. To be captured through interview and indicated according to option list:

Options	Description/definition	Code
Decreasing	Decreased tree density expected within 5 years	1
Stable	No change in tree density expected within 5 years	2
Increasing	Increased tree density expected within 5 years	3

- **Shrub cover (92a):** vertical projection of the shrub/bush canopies as percentage of the total ground area. To be indicated according to option list:

Options	Description/definition	Code
No shrubs		0
< 5%	Very few shrubs	1
5-10%	Sparse shrub canopy cover	2
10-40%	Very open shrub canopy cover	3
40-70%	Open shrub canopy cover	4
>70%	Closed shrub canopy cover	5

- **Shrub height (92b):** average height of the shrubs, in meters.

- **Herbaceous cover (92d):** vertical projection of the herbaceous plants/ natural grass as percentage of the total ground area. To be indicated according to option list:

Options	Description/definition	Code
No herbaceous		0
< 5%	Very few herbaceous	1
5-10%	Sparse herbaceous canopy cover	2
10-40%	Very open herbaceous/ natural grass cover	3
40-70%	Open herbaceous/ natural grass cover	4
>70%	Closed herbaceous/ natural grass cover	5

- **Plant residues cover (92e):** vertical projection of the plant residues as percentage of the total ground area. To be indicated according to option list:

Options	Description/definition	Code
No plant residues		0
< 5%	Very few plant residues	1
5-10%	Sparse plant residues canopy cover	2
10-40%	Very open plant residues cover	3
40-70%	Open plant residues cover	4
>70%	Closed plant residues cover	5

- **Crop residues cover (92f):** vertical projection of the crop residues as percentage of the total ground area. To be indicated according to option list:

Options	Description/definition	Code
No crop residues		0
< 5%	Very few crop residues	1
5-10%	Sparse crop residues canopy cover	2
10-40%	Very open crop residues cover	3
40-70%	Open crop residues cover	4
>70%	Closed crop residues cover	5

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Drainage:

- **Waterlogging (74b):** soil drainage reflected by the time water remains on the surface after a heavy rainfall and resulting waterlogging. Can be obtained from informants. To be described according to option list:

Options	Description/definition	Code
Not applicable	Includes urban areas, quarries	**0**
No drainage	Land covered with water most of the year, such as lakes, swamps and mangroves, etc.	**1**
Poor drainage	Significant surface ponding (lying water) for several months	**2**
Moderate drainage	Water/humidity may stay in the soil for several weeks	**3**
Good drainage	No evidence of surface ponding after one day following heavy rain However, water/ humidity may stay in the soil for a weeks	**4**
Very good drainage	Moisture/water does not stay in the soil during more than a few consecutive hours. E.g. sandy soils will dry out rapidly	**5**

- **Impeded/filtering capacity (74c):** filtering capacity of wetlands. To be described according to option list:

Options	Description/definition	Code
Not applicable	Not a wetland	**0**
Low filtering capacity	A wetland that does not traps sediments, excess nutrients and other pollutants such as heavy metals. Therefore the water coming in the wetland has the same quality (e.g. colour) as the one going out	**1**
Medium filtering capacity	A wetland that traps some amount of sediments and retains some excess nutrients and other pollutants such as heavy metals. Therefore the water coming in the wetland is slightly different in quality (e.g. colour) as the one going out	**2**
High filtering capacity	A wetland that traps sediments and retains excess nutrients and other pollutants such as heavy metals. Therefore the water coming in the wetland is significantly different in quality (e.g. colour) as the one going out. High density of vegetation	**3**

Environmental problems:

- **Environmental problem category (84):** main environmental problems observed/identified within the LUCS. To be asked also to informants. To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
None identified	No problem has been identified in the LUCS	**0**
Reduced water levels in rivers / wetlands	In a period of time a considerable reduction of water levels can be noticed	**1**
Dried up of water source	The main resources of water have dried up	**2**
Rainfalls variability	In a period of time a change pattern in rainfalls is noticed and is affecting agriculture production or other human activities	**3**
Drought	Continuous periods of dry weather that usually affects agriculture or other human activities	**4**
Floods	Inundation of land that is normally dry through the overflowing and usually rising of a body of water	**5**
Poor water quality	The water does not meets the main quality needs for the population	**6**

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Air pollution	Disturbances caused by air pollution	7
Erosion	Soil is carried away in the landform to the extent that gullies and other erosion signs can be observed	8
Loss of soil fertility	Nutrients of soil are being reduced to the extent that the crop yields are reduced due to intensive use of chemical inputs, soil erosion, poor soil management practices or other	9
Reduced yields	The production of certain crop is drastically reduced as compared to the previous seasons	10
Dust storm	Windstorm that lifts up large amount of soil, sand and dust particles	11
Hail storm	Frozen rain falling as little balls of ice that affect agriculture	12
Uncontrolled burning	Fire which threatens to destroy life, property, or natural resources, and is not burning within the confines of firebreaks or is burning with such intensity that it could not be readily extinguished	13
Landslide	Sliding of a large mass of rock material, soil, etc., down the side of a mountain, hill or cliff	14
Wind fall/ Wind blow	Including storms, cyclones…	15
Overexploiting resources	A resource its used in a way that its natural recuperation its not enough to maintain it	16
Overgrazing	Excessive loss of herbaceous vegetation cover due to wildlife or livestock grazing	17
Loss of habitats	The number of ecosystems are being reduced	18
Reduced species diversity	Plant and animal species diversity is drastically reduced	19
Animal disease and mortality	Diseases start decreasing the animal population (livestock/ wildlife)	20
Plant pest	Pests start affecting plants in the area	21
Invasive species	Species that are non-native to the ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health	22
Other	To be specified	

- **Severity (84c):** severity of identified problem. To be indicated according to the following option list:

Options	Description/definition	Code
Low	The evidence of the problem is not so visible	1
Medium	There are some visible effects of the problem that are starting to affect	2
High	It is visible that the problem is strongly affecting	3

- **Trend (84d)**: trend in the severity of the problem during the last 5 years. To be indicated according to option list:

Options	Description/definition	Code
Decreasing	There are visible signs that the problem detected is reducing	1
No change	There are visible signs that the problem has not change in the last 5 years	2
Increasing	There are visible signs that the problem detected is increasing	3
Not known	There is not enough information to know the trend in the severity of the problem	90

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- **Soil erosion (84e):** type of erosion observed/identified within the LUCS. To be indicated by marking the appropriate checkboxes (multiple choice possible):

Options	Description/definition	Code
No soil erosion	No evidence of soil erosion	**0**
Gullies	Evidence of erosion shown by deep excavation of soils mainly caused by excessive water and exposing bare rocks at the bottom	**1**
Rills	Evidence of erosion shown by removal of surface soils and mainly caused by droplets of rain water	**2**
Sheet	Evidence of erosion shown by even removal of the surface layer of the soil mainly caused by water moving runoffs	**3**
Pedestals		**4**
Root exposure	There is not enough soil therefore the roots of the plants are exposed	**5**
Sedimentation (behind trees)	Accumulation of sediments around the tree stem base	**6**
Sealing	Pores of surface soil are drastically reduced to the extent that infiltration is impeded	**7**
Water ponding	Pools of water accumulates in the surface soils	**8**
Siltation	Movement of fine soil particles that are accumulated along water channels, river banks and flat plains	**9**
Abrasion		**10**
Rock outcrops	Rocks protrusions from surface of the soil due to erosion processes	**11**
Dunes	Accumulation of sandy soils due to wind erosion resulting into hilly topography	**12**
Other	To be specified	

Fire:

- **Fire evidence (85):** the presence or absence of fire evidence in the LUCS. To be indicated according to options list:

Options	Description/definition	Code
No evidence of fire	There is no evidence of fire	**0**
Recent fire	Evidence of fire from the current season/year	**1**
Old fire	Evidence of fire from previous years but not from current season	**2**

- **Fire area (86):** surface of fire in the LUCS. To be indicated in square meters.
- **Fire type (87):** to be indicated according to option list (multiple choice possible):

Options	Description/definition	Code
No evidence of fire		**0**
Underground fire	Fire spreading under the surface through roots or any other underground means	**1**
Surface fire	Fire spreading through the ground cover where it consumes litter and ground vegetation without reaching the tree canopies	**2**
Crown fire	Fire spreading through the canopies of woody vegetation	**3**

- **Causes of fire (87b):** main purposes for the fire. To be indicated according to option list (multiple choice possible):

Options	Description/definition	Code
No evidence of fire	No fire	0
Natural	Natural fire (lightning)	1
Accidental	Accidental fire due to negligence (cigarette, campfire...)	2
Clearing of new land	Fire is used to removed the vegetation for the purpose of changing the land use (e.g. conversion forest to agriculture use)	3
Clearing of weeds and residues	Fire is applied to remove weeds and residues, for planting or other use	4
Pasture regrowth	Fire that is created to stimulate grassland growth for pasture regeneration	5
Pest and vermines control	Fire is caused for removing/managing rodents, snakes…	6
Arson / Malice	Fire is used in a premeditated, for destruction purposes (incendiary)	7
Industrial activities	Fire is caused by industrial activities	8
Not known	There is not enough information to know the fire purpose	90
Other	To be specified in the notes	99

Wildlife (to be inserted in part B for an NFI):

- **Wildlife disturbances (94c)**: impact level of wildlife activity in the resources. To be indicated according to option list:

Options	Description/definition	Code
Not disturbed	No disturbance detected	0
Slightly disturbed	There is minimal evidence that wildlife is disturbing the resources	1
Moderately disturbed	There is some evidence of disturbance in the resources caused by wildlife	2
Heavily disturbed	There is high evidence of disturbance to resources by wildlife	3

Grazing / rangeland (to be inserted in part B for an NFI):

- **Grazing activity (138):** indicates if grazing activity (domestic animals) is carried out in the Land Use/Cover Section (Y/N).
- **Grazing overall quality (139a):** indicates the overall quality of land resources for grazing. To be indicated according to an option list:

Options	Description/definition	Code
Not applicable	Urban area, water course	0
Low	Evidence that the grazing land has poor pasture quality (e.g. few pasture species and sparse, < 20% pasture cover)	1
Medium	Evidence that the grazing land has moderate pasture quality (between 20-49% pasture cover)	2
High	Evidence that the grazing land has good pasture quality (abundant and dense pasture, > 50% pasture cover)	3

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- **Quality trend (139b)**: trend in the quality of the grazing/ rangeland during the last 5 years. To be asked to informant and indicated according to option list:

Options	Description/definition	Code
Not applicable	Urban area, water course	0
Decreasing	When there are visible signs that the quality trend is reducing in the last 5 years	1
No change	When there are visible signs that the quality has not change in the last 5 years	2
Increasing	When there are visible signs that the quality trend is increasing in the last 5 years	3
Not known	There is not enough information to know the quality trend of the grazing/rangeland	90

Photos:

- **Photo Nº (701):** sequential photo number(s) in the SU (from 1 to the total number of photos taken within the SU) of the photo (s) taken to describe the Land Use/Cover section.
- **Description (702):** brief description of the photo(s)**.**
- **X (702d) and X (702c):** easting and northing coordinates, in meters given by the GPS where the photo is taken, in the projection system adopted in the country.
- **Bearing (702a):** compass reading, in degrees, of the photo (0-360º).

B.   Forest and other wooded land (and woodlots) management and structure

This section should be filled out only for LUCS within forest and other wooded land.

- **Stand origin (90):** to be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
Natural	Natural regeneration of stand by seed	N
Plantation	Artificial regeneration by seeding or planting	P
Coppice	Regeneration by shoots from stump or roots	C
Not known	There is not enough information to know about the stand origin	nk

- **Vertical stand structure (91):** distinct canopy layers in the stand. A canopy layer is a group of tree crowns forming a clearly distinct stratum from the crowns of other trees. To be indicated according to an option list:

Options	Description/definition	Code
Not applicable	Non forest area	0
Single layer	Stand with only one well-defined layer formed by the tree canopies	1
Two-layer vegetation	Stand with two distinct canopy layers, an upper layer (a dominant canopy layer with the highest crown and receiving the most light) and a lower layer (under storey, with tree top more or less dominated by the dominant layer)	2
Three-layer vegetation	Stand with three, well distinct, canopy layers: - a dominant upper layer - an intermediate layer (quite dominated by the upper layer) - a lowest layer (under storey, clearly dominated by the dominant layer)	3
Multilayer	Stand with more than three distinct canopy layers	4

- **Forest ownership (83b):** legal right to freely and exclusively use, control, transfer, or otherwise benefit from a forest. It refers to the ownership of the **trees** regardless of whether or not it coincides with the

land ownership. To be indicated according to option list:

Options		Description/definition	Code
Private	Individual	Forest owned by individuals and families	1
	Industries	Forest owned by private enterprises or industries	2
	Local communities	Forest owned by a group of individuals belonging to the same community residing within or in the vicinity of a forest area. The community members are co-owners that share exclusive rights and duties, and benefits contribute to the community development	3
	Others private	Forest owned by private co-operatives, corporations, religious and educational institutions, pension or investment funds, NGOs, nature conservation associations and other private institutions (religious, educational, etc.)	4
Public	State	Forest owned by central government, or by government-owned institutions or corporations	5
	Local government	Forest owned by local government (district, municipalities)	6
Indigenous / Tribal communities		Forest owned by community of indigenous or tribal people	7
Not known		No information available on the forest ownership	90
Other		To be specified. Also includes areas where ownership is unclear or disputed	

- **Management plan (93):** indicates whether a formal forest or woodland management plan exists and if it is being implemented. To be indicated according to option list:

Options	Description/definition	Code
No formal management plan	No formal management plan formulated or formal management plan formulated but not implemented	0
Formal management plan	Formal management plan formulated and implemented	1
Not known	There is not enough information to know about any existing management plan in the area	90

- **Human disturbances (94)**: impact level of human activity in the forest or other wooded land. To be indicated according to option list:

Options	Description/definition	Code
Not disturbed	Protected areas, all resources conserved	0
Slightly disturbed	Exploitation of goods and services is carried out according to management plans	1
Moderately disturbed	Many products collected without conforming to management plans, notion of sustainability not respected	2
Heavily disturbed	Removal of products at rates higher than Mean Annual Increment (MAI), biodiversity degradation due to high pressure on selected species, encroachment of agriculture leading to high rate of deforestation	3

- **Disturbance types (94b)**: the types of human disturbances affecting the forest or other wooded land. To be indicated according to option list:

Options	Description/definition	Code
Not disturbed		0
Encroachment by agriculture	Conversion of forests into agricultural land	1
Overexploitation	The forest resources are extracted at a rate higher than the rate of regeneration	2

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Settlements	Settlements (dwellings) cause disturbances	**3**
Quarry and mineral exploration	Forests resources are cleared to pave way for querying and mining	**4**
Urban infrastructure development	Forests resources are cleared to pave way for infrastructure development (e.g. roads, water treatment plants...)	**5**
Other	To be specified in the notes	**99**

- **Timber harvesting (95):** tree harvesting system applied in the LUCS. To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
No felling	No recent felling observed	**0**
Clear-cutting	Clear felling. All or almost all trees in a stand have been harvested	**1**
Seed tree cutting	The majority of trees are cleared from a stand with a few select ones remaining as seed trees	**2**
Single tree selective cutting	Selective felling extracting only trees of certain species, dimensions, quality, value, etc.	**3**
Group felling	Extraction of groups of trees	**4**
Strip felling	Extraction of strips of trees	**5**
Other	To be specified	

- **Stumps removal (95c):** indicate if the stumps are removed after exploitation by "**Y**" (=**yes**) and "**N**" (=**no**).

- **Branches and tops removal (95d):** indicate if the branches and top trees are removed after exploitation by "**Y**" (=**yes**) and "**N**" (=**no**).

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- **Silviculture (96):** visible silvicultural practices. To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
No silvicultural practice		0
Pruning	To cut away some of the branches to improve the tree shape, bole and wood quality	1
Thinning	Reduction of trees to allow for the development of desired future trees	2
Coppicing	Tree stems are repeatedly cut down at or near at the ground to allow many new shoots to emerge from the stump	3
Pollarding	The growth of new lateral branches is encouraged by cutting tree stem above the ground (usually 2 or 3 meters) or main branches. Pollarding is maintained through regular pruning	4
Enrichment planting/seeding – Indigenous sp	Supplementary planting or seeding of indigenous species for increasing the percentage of desirable species	6
Enrichment planting/seeding – Exotic sp	Supplementary planting or seeding of exotic species for increasing the percentage of desirable species	7
Cleaning /Weeding	Intervention aimed at freeing trees from disturbing vegetation layer (e.g. lianas)	5
Sanitary cutting	Removal of dead, damaged or unhealthy trees, with the aim of stopping or preventing the spreading of insects and diseases	8
Prescribed burning	Controlled application of fire to vegetation in either their natural or modified state, under specified environmental conditions which allow the fire to be confined to a predetermined area and at the same time to produce the intensity of heat and rate of spread required to attain planned resource management objectives	9
Fire break	Creation and maintenance of a discontinuity in the forest stand in order to stop or reduce fire intensity and effectively control it at specific points	10
Other	To be specified	

- **Logging technology (97)**: technology used for tree exploitation, including for cutting and removal (wood transportation from the logging area to the road). To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
Not applicable	No timber exploitation	0
Manual	Manual saw, axe, machete, etc.	1
Chainsaw	Chainsaw	2
Mechanized	Tractors, mechanization, etc.	3
Animal	Use of oxen, elephants, buffaloes, donkeys, horses, etc for wood removal	4
Not known	There is not enough information to know about the logging technology	90
Other	To be specified	

- **Notes (98a):** notes concerning forests and OWL management.

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- **Soil and water conservation (144):** practices for protection against erosion and for soil and water conservation. To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
None		**0**
Levelling	Reduction of sloppiness of the land	**1**
Contour farming	Field operations, such as ploughing, planting, cultivating, and harvesting are done along the contour	**2**
Terracing	Terracing of the land	**3**
Crop residue incorporation	Crop residues are left on the soil to become part of the organic matter	**4**
Cover crops / vegetation	Maintenance of dense vegetation to prevent soil from erosion	**5**
Mulching	Material such as straw, plant residues, leaves, stubbles, loose soil or plastic film is placed on the soil surface to reduce evaporation and erosion, suppress weeds and protect plant roots from extremes of temperature	**6**
Windbreak	Trees planted on strips to protect crops from the wind	**7**
Grassed waterway / Check dams	Strips of grass seeded on in areas of cropland or small, temporary or permanent dam constructed across a drainage ditch or channel, aiming at reducing the rate of water flow or at preventing severe erosion	**8**
Tree planting / Agroforestry	Tree planting for soil and water conservation	**9**
Not known	There is not enough information to know about the soil and water conservation	**90**
Other	To be specified	

- **Notes (98b):** general notes concerning the LUCS, forest management, cropping activities, reasons and problems concerning the choice of the LUCC.

F5

5.6   Form F6: Land Use/Cover Class (LUCC) – Products and Services

This form (see Annex 6.9) contains the information on services and forest and tree products provided by the Land Use/Cover Class. The form also includes information on invasive, threatened and extinct species as well as on land use conversion trends.

One form will be completed for each land use/cover class found in the SU (in all 4 plots). Most of the information will be collected through interviews (key informants, focus groups, individuals) and observations and organized in a summary forms (**F6a** and **F6b**). The form **F6b** is used to record additional products, if there is not enough space in the product table in form **F6a**. Primary data from the interviews or observations will be recorded in the **F6(p)** form (see Annex 6.9).

Plot identification

- **Country name (1).**
- **SU Nº (2):** identification number of the sampling unit (from 1 to total SU number).
- **Plot Nº (3):** identification number of the plot (1 to 4).
- **LUCC (80):** code describing the land use/cover (LUCC) class, according to classification given in section 2.

Only for F6(p) (primary data recording form): it should be as many F6p as interviews carried out + one for the observations made by the field team.

- **Interview No (99r)**: identification number of the interview (from 1 to the total number of interviews carried out, excluding household survey). The observations made by the field team members will also count as one interviewee.
- **Information source (124)**: the source of the data (interviewee types or observation) used to compile the form **F6p.** See also Table 6. To be indicated according to option list:

Options		Description/definition	Code
Observations			1
Key informant	**Internal key informant**	Individuals living in the area/ within the community with in-depth knowledge about the area, the local settings, the use of land and natural resource use	2
	External key informant	Individuals living outside the area with particular knowledge about the area, the land/ natural resource use and the local community (e.g. local government officials, leaders of local development organisation, school)	3
Focus groups or individuals		Representative group or individual living in the area and/or using forest and land resources	
	Women		4
	Men		5
	Youth		6
	Owners		7
	Long term resident		8
	Nomadic		9
	Hunter and gatherer		10
	Logging company		11
	Farmer		12
	Pastoralist		13
	Fishermen		14
	Other	To be indicated in the note	99

- **Interviewee number (201d):** the number of persons who participated to the interview (excluding team members, if they are not informants).

1. **Products harvested in the land use class (F6a/b)**

This table is used to record the forest and trees harvested in the land use class (livestock pro**c**ts are excluded). If the table is not big enough, the field form **F6b** can be used to record other products.

- **Product category (99):** categories of products harvested in the Land use/ cover class (one line for each product category). To be indicated according to option list:

Options		Description/definition	Code
Wood products	Industrial roundwood	Wood that is used for industrial purposes, either in its round form (e.g. as transmission poles or piling) or as raw material to be processed into industrial products such as sawn wood, panel products or pulp	101
	Fuelwood	Wood in the rough such as branches, twigs, logs, chips, sawdust and pellets, used for energy generation	102
	Wood charcoal	Product of wood combustion used as fuel	103
	Wood carvings	Tools, household equipment, carvings and other small woods	104
Cash crops		Crops used mainly for sale (oil, fibber, food, beverage...)	200

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Plant products (other than cash crops)	**Plant food for human consumption**	Vegetable foodstuffs and beverages including fruits, nuts, seeds, roots, mushrooms, food crops, etc.	**201**
	Fodder	Animal and bee fodder provided by leaves, fruits, flowers, etc.	**202**
	Plant medicines	Medicinal plants (e.g. leaves, bark, roots) used in traditional medicine and/or for pharmaceutical companies	**203**
	Soap / Cosmetics	Aromatic plants providing essential (volatile) oils and other products used for cosmetic purposes such as soaps, perfumes	**204**
	Dyeing / Tanning	Plant material (bark, fruits and leaves) used as tannins, colorants or dyeing	**205**
	Herbs and spices	Food additives	**206**
	Exudates	Substances such as gums (water soluble), resins (water insoluble) and latex (milky or clear juice), released from plants by exudation	**207**
	Utensils, handicrafts	Non wood utensils and handicraft made of thatch, bamboo, rattan, leaves and fibres, wrapping leaves, etc	**208**
	Construction material	Non wood construction material made of thatch, bamboo, rattan, leaves and fibres	**209**
	Ornamentals	Entire plants (e.g. orchids) and parts of plants (e.g. pots made from roots) used for ornamental purposes	**210**
	Seeds	Seeds collected for regeneration purposes	**211**
	Fuel	Combustion materials	**212**
	Fibber	For instance for making clothes	**213**
	Fertilizer	Additives to improve soil fertility	**214**
	Other plant products	To be specified	**299**
Animal products	**Living animals**	Mainly vertebrates such as mammals, birds (parrots), reptiles kept/bought as pets (including for zoos)	**301**
	Honey, beeswax	Products provided by bees	**302**
	Bush meat	Meat provided by vertebrates, mainly mammals	**303**
	Other edible animal products	Mainly edible invertebrates such as insects (e.g. caterpillars) and other "secondary" products of animals (e.g. eggs, nests)- To be specified	**398**
	Hides / Skins	Hide and skin of animals used for various purposes. Includes trophies	**304**
	Medicines from animals	Entire animals or parts of animals such as various organs used for medicinal purposes	**305**
	Colorants	Entire animals or parts of animals such as various organs used as colorants	**306**
	Fuel	Biogas, dung	**307**
	Other non-edible animal products	E.g. bones used as tools – To be specified	**399**

- **Product category importance (99a):** ranking of the product category according to importance. To be indicated according to option list:

Options	Description/definition	Code
Low	Product category of low importance	**1**
Medium	Product category of medium importance	**2**
High	Product category of high importance	**3**

- **Species / Varieties (111):** local or scientific name of species, in the product category, harvested in the land use class (one line per species/ varieties). If a local name is used then the language used to name the species should be specified into brackets. If several species have very similar characteristics (see following variables), they can be noted in the same row.

- **Species ranking (111a):** ranking of the species according to importance. To be indicated according to option list:

Options	Description/definition	Code
Low	Species of low importance	**1**
Medium	Species of medium importance	**2**
High	Species of high importance	**3**

- **Part (111b):** part (s) (seed, bark, leaves...) harvested of the plant product. To be indicated according to option list (multiple choice possible):

Options	Description/definition	Code
Not applicable	Not a plant product (animal products...)	**0**
All	All the plant (aboveground is harvested)	**1**
Branches		**2**
Trunk		**3**
Stump		**4**
Roots		**5**
Bark		**6**
Leaves		**7**
Seeds		**8**
Fruits		**9**
Flowers		**10**
Other	To be indicated in the notes	**99**

- **Commercial end-use (102):** main end-use of the species. To be indicated according to option list:

Options	Description/definition	Code
Only domestic use	The product is only used for home consumption. No commercial use of the product	**0**
<25% commercial use	Less than 25% of the product is sold in markets (more than 75% of the product is used for home consumption)	**1**
25-50% commercial use	25% to 50% of the product is sold in markets (50% to 75% of the product is used for home consumption)	**2**
50-75% commercial use	50% to 75% of the product is sold in markets (25% to 50% of the product is used for home consumption)	**3**
>75% commercial use	More than 75% of the product is sold in markets (less than 25of the product is used for home consumption)	**4**
Only commercial use	All harvested product is sold. The product is not used for home consumption	**5**
Not known	There is not enough information to know about the commercial use of the specie	**90**

- **Conflicts (104):** existence of conflicts between different users/harvesters of the product. To be indicated according to option list:

Options	Description/definition	Code
No	No conflicts due to use/harvest of the product	**1**
Yes	Conflicts due to use/harvest of the product	**2**
Not known	There is not enough information to know about conflicts of harvesting the product	**90**

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- **Demand trend (105)**: trend of product demand during the last 5 years. To be indicated according to option list:

Options	Description/definition	Code
Not applicable		0
Decreasing	When there are signs that the demand trend of product is decreasing for the last 5 years	1
No change	When there are signs that the demand trend of product has been the same for the last 5 years	2
Increasing	When there are signs that the demand trend of product is increasing for the last 5 years	3
Not known	There is not enough information to know about demand trend	90

- **Supply trend (106):** trend of product supply or stock during the last 5 years. This variable should not to be recorded for crop products. To be indicated according to option list:

Options	Description/definition	Code
Not applicable		0
Decreasing	When there are signs that the supply trend of product is decreasing for the last 5 years	1
No change	When there are signs that the supply trend of product has been the same for the last 5 years	2
Increasing	When there are signs that the supply trend of product is increasing for the last 5 years	3
Not known	There is not enough information to know about supply trend	90

Harvest:

- **Harvest period (107b-107c):** period of harvest of the product, indicated as starting month and end month (Month-Month). For instance, if the harvest is done from September to December then indicate "09-12"; from November to February "11-02"; the whole year "01-12".

- **Harvest frequency (108):** frequency of harvesting of the product during the harvest period. To be indicated according to option list:

Options	Description/definition	Code
Not applicable		0
Daily	Product is harvested almost every day during the harvest period	1
Weekly	Product is usually harvested at least once every week during the harvest period (but not daily)	2
Monthly	Product is usually harvested at least once a month during the harvest period (but not weekly)	3
Yearly	Product is usually harvested one or several times a year during the harvest period (but not monthly)	4
Intervals larger than 1 year	Product is not harvested every year	5
Not known	There is not enough information to know about frequency of harvesting the product	90
Other	To be specified in the notes	99

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- **Harvest trend (109):** trend in harvesting of the product during the last 5 years. To be indicated according to option list:

Options	Description/definition	Code
Not applicable		**0**
Decreasing	When there are signs that the trend in harvesting the product is decreasing for the last 5 years	**1**
No change	When there are signs that the trend in harvesting the product has been the same for the last 5 years	**2**
Increasing	When there are signs that the trend in harvesting the product is increasing for the last 5 years	**3**
Not known	There is not enough information to know about the trend in harvesting the product	**90**

- **Harvest change reason (110)**: main reason of change in harvesting of the product during the last 5 years. To be indicated according to option list:

Options	Description/definition	Code
Not applicable		**0**
Change in benefits	Changes in benefits perceived for the product (change in market price or harvest costs)	**1**
Change in demography	Change in population increases or decreases the demand for the product	**2**
Competition with other products	The products have been substituted by or substituted other products	**3**
Change in the quantity of product in the surroundings	Change in the quantity/ stock of the product in the surrounding (due to climate change, overexploitation, soil conditions, invasive species...)	**4**
Change in the access to the resource	Change in the access to the resource due to land tenure	**5**
Change in harvesting techniques	Change in technology for harvesting / transporting the product	**6**
Not known	There is not enough information to know about the change reason in harvesting the product	**90**
Other	To be specified in the notes	**99**

- **Market price (266a):** market price of the product in national currency per Unit.
- **Market price unit (266b):** market price unit of the product (eg. kg, unit, dozen...).

User group: each line from this section of the table corresponds to a user group for the **product category** (not anymore to the product species).

- **User group (101):** the user group (harvesters) of the product category is indicated by marking the following codes:

Options	Description/definition	Code
Individuals	Individuals and families	**I**
Communities	Group of families living together	**C**
Enterprise	Includes public or private enterprises, industries and organizations	**E**
Nomadic	Nomadic or transhumant user (individuals or communities)	**N**

- **User group ranking (101a):** ranking of the user groups according to the harvested quantity of the product category. To be indicated according to option list:

Options	Description/definition	Code

Low	User group with low harvest of the product	1
Medium	User group with medium harvest of the product	2
High	User group with high harvest of the product	3

- **User rights (103):** user rights to harvest the product (by product category). To be indicated according to option list:

Options	Description/definition	Code
Individual rights	The harvester is the land owner or has been transferred property rights	1
Rent	Pays a fee, percentage of harvest, for having the right of harvest the product	2
Customary or common rights	Rights to harvest the product based on tradition or habit, to satisfy local people's needs or a specific group. Might be regulated through permits and licenses	5
Open access	The harvest of the product is a common right. Everybody has the right to harvest/use the product.	6
No right	The harvest of the product is prohibited	7
Not known	There is not enough information to know about the user rights	90

- **Sale to (268):** main destination of sold product (by product category). To be indicated according to option list:

Options	Description/definition	Code
Not applicable	The product is not sold	0
Local market	Product sold mainly to local market > 70%	1
Regional market	Product sold mainly to regional market > 70%	2
Middleman	Over 70 % of the product sold to an intermediate person(s) involved in the chain between the producer and the final buyer e.g. exporters, cooperatives…	3
Not known	There is not enough information to know about where the product is sale to	90

- **Organization level (101b):** level of organization in which the harvest is carried out. To be indicated according to option list:

Options	Description/definition	Code
Organized	Harvesting is carried out in a coordinated manner	1
Spontaneous	Harvesting is carried out in a spontaneous, non organized manner	2
Organized and spontaneous	Harvesting is carried out both in a coordinated and spontaneous manner	3

- **Gender balance (101c):** gender balance of harvesters of the product. To be indicated according to option list:

Options	Description/definition	Code
No women	Women don't harvest the product	0
<30% women	Women represent less than 30% of the harvesters of the product	1
30 – 70% women	Women represent between 30 – 70% of the harvesters of the product	2
>70% women	Women represent more than 70% of the harvesters of the product	3
Only women	Only women harvest the product	4

- **Child participation (101d):** proportion of children involved in the work related to harvest. To be indicated according to option list:

Options	Description/definition	Code
No children	Children don't harvest the product	**0**
<30% children	Children represent less than 30% of the harvesters of the product	**1**
30 – 70% children	Children represent between 30 – 70% of the harvesters of the product	**2**
>70% children	Children represent more than 70% of the harvesters of the product	**3**
Only children	Only children harvest the product	**4**

Legislation:

- **Awareness (101e):** awareness of the legislation related to the harvest of the product. When major part of the user group is aware of the legislation this should be indicated by marking the checkbox. When there are no legislation related to the harvest of the product then "n.a." (not applicable) should be indicated.
- **Compliance (101f):** compliance to legislation for the product. If the majority of the user group acts in compliance with the legislation this should be indicated by marking the checkbox. When there are no legislation related to the product then "n.a." (not applicable) should be indicated.

Incentives:

- **Awareness (101g):** awareness of incentives related to the product. If the majority of the user group is aware of the incentives this should be indicated by marking the checkbox.
- **Application (101h):** application to incentive for the product by legal users. If the majority of the user group has applied or is applying for incentives this should be indicated by marking the checkbox.

2. Services provided by the forest and trees) (F6a)

- **Service category (148):** service provided by the forest and trees, as perceived by local population. To be indicated by marking the appropriate checkbox (multiple choice possible):

Options	Description/definition	Code
None identified		**0**
Soil protection	Including soil conservation, watershed protection, protection against erosion and landslides	**1**
Soil fertility	Contributes to good fertility	**2**
Fresh water / water conservation	Contributes to fresh water/water conservation	**3**
Detoxification / water purification	Contributes detoxification/water purification	**4**
Climate regulation	Contributes to regulates climate	**5**
Disease control	Provides a barrier from diseases	**6**
Windbreak	Acts as a windbreaker	**7**
Shade	Provides shade	**8**
Religious/Spiritual	Use for religious purposes	**9**
Cultural heritage	For cultural heritage	**10**
Recreation / Tourism	Including ecotourism, hunting or fishing as leisure activity	**11**
Aesthetic	Provides landscape beauty	**12**

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Education / Scientific studies	Use for education, researches, including bio-prospecting	13
Employment	Provides local employment	14
Other	To be specified	

- **Service importance (148b):** importance of the service provided, as perceived by local population. To be indicated according to option list:

Options	Description/definition	Code
Low	Service of low importance	1
Medium	Service of medium importance	2
High	Service of high importance	3

Service legislation:

- **Awareness (101e):** awareness of the legislation related to the service provided. When major parts of the user group are aware of the legal restrictions this should be indicated by marking the checkbox. When there is no legislation related to the service then "n.a." (not applicable) should be indicated.
- **Compliance (101f):** compliance to legislation for the service provided. If the majority of the user group acts in compliance with the legislation this should be indicated by marking the checkbox. When there is no legislation related to the product then "n.a." (not applicable) should be indicated.

Service incentives:

- **Awareness (101g):** awareness of incentives related to the service provided. If the majority of the user group is aware of the incentives this should be indicated by marking the checkbox.
- **Application (101h):** application to incentive for the service provided by legal users. If the majority of the user group has applied or is applying for incentives this should be indicated by marking the checkbox.

3. Biodiversity indicators (F6a)

Insect pests, diseases and invasive species (160):

- **Insect pest, diseases and invasive species category (160a):** category of major diseases, pests and invasive species observed/identified within the land use class. Invasiveness is identified according to local population's perception. To be indicated according to option list:

Options	Description/definition	Code
Insect pest	Exotic insect species in the habitat that is exponential increasing in population	1
Disease	Bacterial, virus or fungal agents causing diseases	2
Fish invasive sp.	Exotic fish species in the habitat that is exponential increasing in population and whose spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health	3
Animal wildlife invasive sp.	Exotic animal wildlife species in the habitat that is exponential increasing in population and whose spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health	4
Woody invasive sp.	Exotic woody species in the habitat that is exponential increasing in population and whose spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health	5

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	Exotic herbaceous species in the habitat that is exponential increasing in population and whose spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health	
Herbaceous invasive sp.		**6**

- **Species (160b):** either common/local or scientific name of the disease, pest or invasive species.
- **Affects (160c):** category affected by insect pest or disease. To be indicated according to option list:

Options	Description/definition	Code
Not applicable	Fish, wildlife, woody or herbaceous invasive species	**0**
Humans	The insect pest or disease affects humans	**1**
Livestock	The insect pest or disease affects livestock	**2**
Fishes	The insect pest or disease affects fishes	**3**
Animal wildlife	The insect pest or disease affects animal wildlife	**4**
Herbaceous plants	The insect pest or disease affects herbaceous plants	**5**
Woody plants	The insect pest or disease affects woody plants	**6**
Other	To be specified in the notes	**99**

- **Severity (160d):** severity of the invasion/ disease. To be indicated according to option list:

Options	Description/definition	Code
Low	There are few visible signs that the disease, pest or invasive specie is affecting the area of land use class	**1**
Medium	There are visible signs that the disease, pest or invasive specie is affecting the area of land use class	**2**
High	The area of land use class is severely affected by the disease, pest or invasive species	**3**

Threatened and extinct species and varieties (161):

- **Threatened and extinct species category (161a):** category of threatened and extinct species or varieties identified within the land use class, as perceived by local population. To be indicated according to option list:

Options	Description/definition	Code
Fish sp.	Fish species in the habitat that is declining exponentially in population within the land use	**1**
Animal sp.	Animal species in the habitat that is declining exponentially in population within the land use	**2**
Woody sp.	Woody species in the habitat that is declining exponentially in population within the land use	**3**
Herbaceous sp.	Herbaceous species in the habitat that is declining exponentially in population within the land use	**4**

- **Species (161b):** either common/local or scientific name of the threatened and extinct species or varieties.
- **Status (161c):** indicate if the specie or variety is extinct or threatened, as perceived by local population. To be indicated according to option list:

Options	Description/definition	Code
Extinct	When population no longer exists	**E**
Threatened	When population is being reduced to a level that in short term can disappear	**T**

Wildlife abundance (162) (Optional):

- **Local or scientific name (112):** name to the main animal wildlife species (big mammals such as e.g. antelope, gazelle...) present in the land use area
- **Abundance (113b):** extent of existence of the named species. To be indicated according to option list:

Options	Description/definition	Code
Low	Low population of the species in the area	1
Medium	Medium population of the species in the area	2
High	High population of the species in the area	3

4. Land use/cover change

This section focuses on identification of any conversion trends from the land use to another and the extent of the conversion process.

- **Conversion (80b):** indicates the rate of conversion according to option list:

Options	Description/definition	Code
None	No conversion from the land use to another over the last 5 years i.e. the land use has been stable	0
Low	The extent of conversion from one land use to another is low i.e. few signs of changes	1
Medium	The extent of conversion from one land use to another is medium over the last 5 years i.e. gradual signs of changes	2
High	The extent of conversion from one land use to another is high over the last 5 years i.e. there has been significant and rapid changes in land use	3

- **To land use (80c):** indicates the land use converted to according to option list.
- **Notes (98):** notes regarding products and services in the land use class and land use/cover change.

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6. Annexes

6.1 Global Land use/ cover classes definitions (FRA 2010)

Categories	Definition
Total area	Total area (of country), including area under inland water bodies, but excluding offshore territorial waters.
Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use. **Explanatory notes:** 1. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters *in situ*. 2. <u>Includes</u> areas with young trees that have not yet reached but which are expected to reach a canopy cover of 10 percent and tree height of 5 meters. It also includes areas that are temporarily unstocked due to clearcutting as part of a forest management practice or natural disasters, and which are expected to be regenerated within 5 years. Local conditions may, in exceptional cases, justify that a longer time frame is used. 3. <u>Includes</u> forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific environmental, scientific, historical, cultural or spiritual interest. 4. <u>Includes</u> windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 hectares and width of more than 20 meters. 5. <u>Includes</u> abandoned shifting cultivation land with a regeneration of trees that have, or is expected to reach, a canopy cover of 10 percent and tree height of 5 meters. 6. <u>Includes</u> areas with mangroves in tidal zones, regardless whether this area is classified as land area or not. 7. <u>Includes</u> rubber-wood, cork oak and Christmas tree plantations. 8. <u>Includes</u> areas with bamboo and palms provided that land use, height and canopy cover criteria are met. 9. <u>Excludes</u> tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations and agroforestry systems when crops are grown under tree cover. <u>Note</u>: Some agroforestry systems such as the "Taungya" system where crops are grown only during the first years of the forest rotation should be classified as forest.

Other wooded land (OWL)	Land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
	
	 Explanatory notes:
	
	 1. The definition above has two options:
	
	  - The canopy cover of trees is between 5 and 10 percent; trees should be higher than 5 meters or able to reach 5 meters *in situ.*
	
	  or
	
	  - The canopy cover of trees is less than 5 percent but the combined cover of shrubs, bushes and trees is more than 10 percent. Includes areas of shrubs and bushes where no trees are present.
	
	 2. Includes areas with trees that will not reach a height of 5 meters *in situ* and with a canopy cover of 10 percent or more, e.g. some alpine tree vegetation types, arid zone mangroves, etc.
	
	 3. Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met.

Other land (OL)	All land that is not classified as "Forest" or "Other wooded land". **Explanatory notes:** Includes agricultural land, meadows and pastures, built-up areas, barren land, land under permanent ice, etc.
Inland water	Inland water bodies generally include major rivers, lakes and water reservoirs.
Outside land area	Sea, ocean or neighbouring countries.

6.2 Tree height and diameter measurements

6.2.1 Tree diameter (Dbh) measurement

Tree diameter is measured over bark, at 1.3 m breast height above the ground (see Figure) with the exception of particular cases mentioned below. Measurement may be carried out with the help of a diameter tape (tape whose diameter unit is in centimetres), or with the use of a calliper. In order to avoid overestimation of the volume and to compensate measurement errors, diameter is measured in cm, and **adjusted in a decreasing sense** (example: 16.8 cm become 16 cm).

Figure 17. Position for diameter measurement at breast height in flat terrain

1.30m
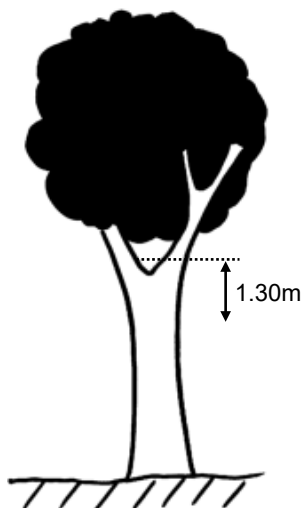
Notes: One single dotted line indicates the place for Dbh measurement. If there are two lines on the stem because of a defective tree, the appropriate place to do the measurement is thus indicated.

Figure. 18. Calliper
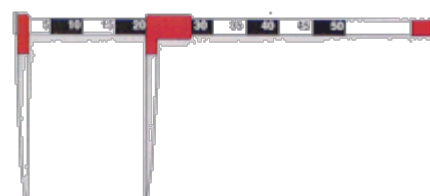
The **calliper** usually has two sides :

- One side of the main axe shows a graded diameter scale in centimetres;
- On the other side of the axe, it shows diameter categories (compensated calliper).

The side in centimetres will be used.

Some preventive measures must be taken into account:

- Measurement instruments are kept in a position that perpendicularly cuts the tree axe at 1.3 m;
- Make sure the calliper tightly holds the stem, in order to prevent the calliper clasps from grasping without compressing the bark;
- If the diametric tape is used, make sure it is not twisted and is well stretched around the tree in a perpendicular position to the stem. Nothing must prevent a direct contact between the tape and the bark of the tree to be measured.
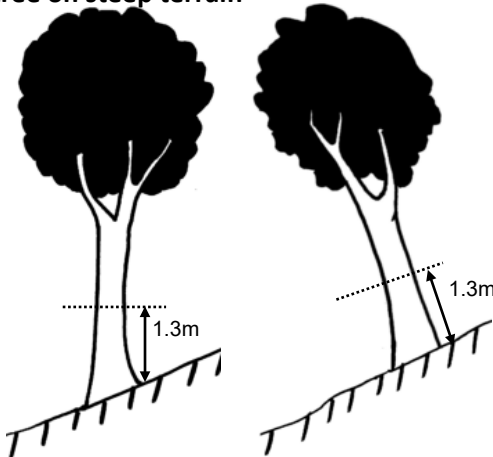
Figure 19. Dbh measurement for non circular tree with calliper

$$d = (d1 + d2)/2$$
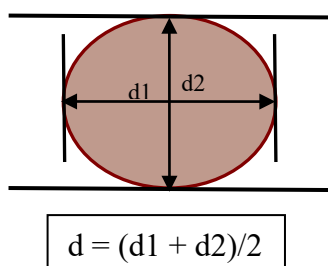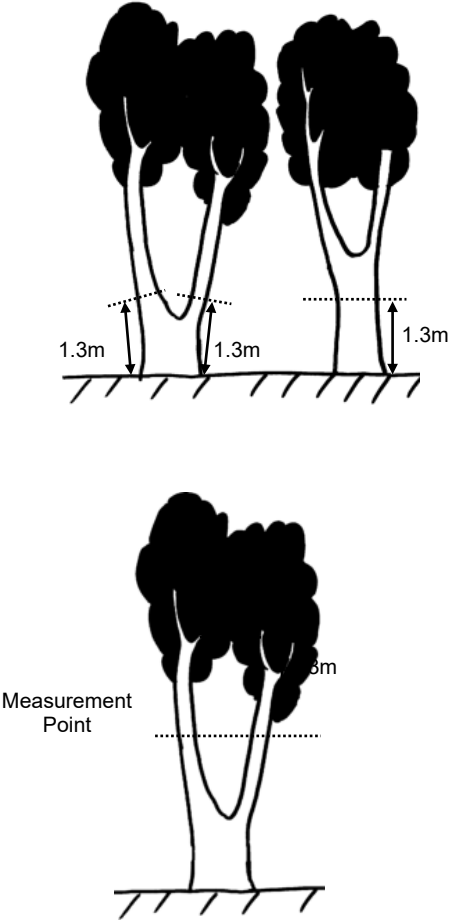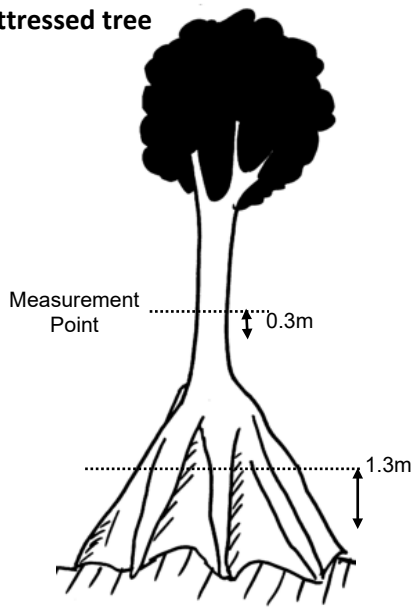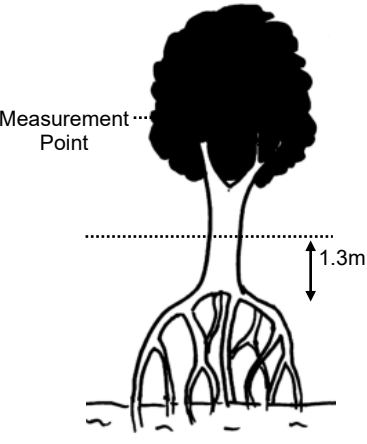
- If the calliper is used, non circular trees are to be measured in two perpendicular diameters located as close as possible to the largest and the smallest diameter, the average of these two is thus retained.

- **Particular cases for diameter (Dbh) measurements:** the Table provides indications on the position for the diameter measurements

for particular cases e.g. trees on inclined terrain, fork trees, etc.

Table 13 Position for diameter measurements – Particular cases

Case	Description of diameter measurement	Figure *Note: see Figure.21*
On inclined terrain	Dbh tree measurement at 1.3 m is taken from an uphill position.	**Figure20. Dbh measurement position for a tree on steep terrain**

Fork tree	Several cases exist, according to the point where the fork divides the stem. • If the **fork begins** (the point where the core is divided) **below 1.30 m height**, each stem having the diameter required (≥20 cm in the whole plot, ≥10 cm for rectangular subplots) will be considered as a tree and will be measured. Diameter measurement of each stem will be taken at 1.3 m height. • **If the fork begins higher 1.3 m height**, the tree will be counted as a single tree and diameter measurement is carried out at 1.3 m. • **If a fork occurs at or immediately above 1.3 m**, the tree will be counted as a single tree and diameter is measured below the fork just beneath any swelling that could inflate the Dbh.	**Figure 21. Dbh measurement position for fork trees** 1.3m 1.3m 1.3m Measurement Point ...3m
Coppice	These are considered in the same way as forked trees. Coppice shoots originating below 1.30 cm are measured as single tree.	

Tree with an enlarged stem base or buttressed tree	Diameter measurement is made at 30 cm above the enlargement or main width of buttress, if the buttress/enlargement reaches more than 90 cm height above the ground.	**Figure 22. Dbh measurement position for buttressed tree** Measurement Point ·········· 0.3m 1.3m
Tree with aerial roots	Diameter measurement is done at 1.3 m from the limit between the stem and roots.	**Figure 23. Dbh measurement position for a tree with aerial roots** Measurement Point ··· 1.3m

Tree with irregular stem at 1.3m	Trees with bulges, wounds, hollows and branches, etc. at breast height, are to be measured just above the irregular point, there where the irregular shape does not affect the stem.	**Figure 24 Dbh measurement position for a tree with branch enlargement at 1.3m** **Figure 25. Dbh measurement position for a tree with branch at 1.3m on a inclined terrain**
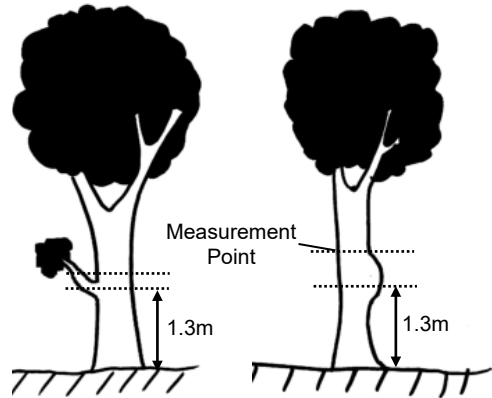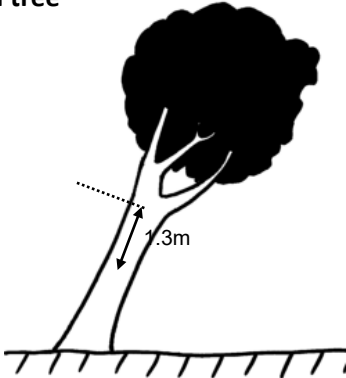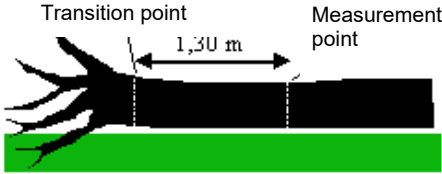
Inclined tree	Diameter measurement is made at 1.3 m. The stem height is measured where the stem base and the ground meet forming the smaller angle.	**Figure 26. Dbh measurement position for an inclined tree** 1.3m
Fallen tree	Diameter measurement is made at 1.3 m from the transition point between the stem and the root.	**Figure 27. Dbh position for a fallen tree** Transition point Measurement point 1,30 m

| Living tree lying on the ground with branches in the shape of a vertical tree | When a living tree is laying on the ground and its vertical branches (at <45° vertical position) grow from the main stem, it is recommended to determine first if the main stem is above the litter or not.

• If he main stem is above the litter, use the same rules applied to a forked tree;

• if the pith of the main stem is under the litter, do not take the main stem into account and treat each one of the branches in the shape of a tree, as a separate tree. Dbh is measured (and its height too) at 1.3 m from the ground, but not from the top of the laying stem. If the top of the laying stem forms a vertical curve, compared to the ground, treat this tree portion as if it was an individual tree, beginning at the point where the pith detaches from the litter. | **Figure 28. Dbh position for tree lying on the ground with branches in the shape of vertical trees**

 |
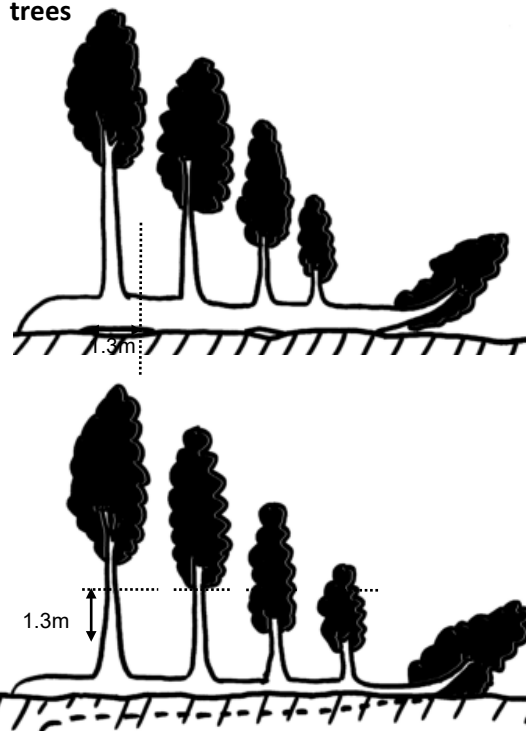
- **If the Dbh is not measured at 1.3 m from the ground**, indicate the height where it was measured in the form **F3** (field "Diameter height").

- **Case of stump**: if the stump height is less than 1.30 m, stump diameter is measured outside bark at stump height, immediately under the cutting point (felling cut) and perpendicular to the longitudinal. If the bark is damaged or missing, a judged addition for bark is done.

6.2.2   Tree height measurement

Tree height measurement may be carried out by means of several instruments such as: dendrometric table, Blume-Leiss, Suunto, Haga, Blitterlich Relascope.

Height measurement is made during several stages:

1. Tree distance (at 15, 20, 30 or 40 meters). To avoid measurement errors, the distance from the tree must be at least equivalent to the tree height;
2. Observation of the tree crown;
3. Observation of the tree base;
4. Addition or subtraction of the two observation results according to the case: addition if the operator is standing uphill (see Figure a), subtraction if the operator is standing downhill in relation to the tree (see Figure b);
5. Slope correction (if needed).

Figure 29. Tree height calculation

$$H=\sqrt{11.7^2+5^2}$$
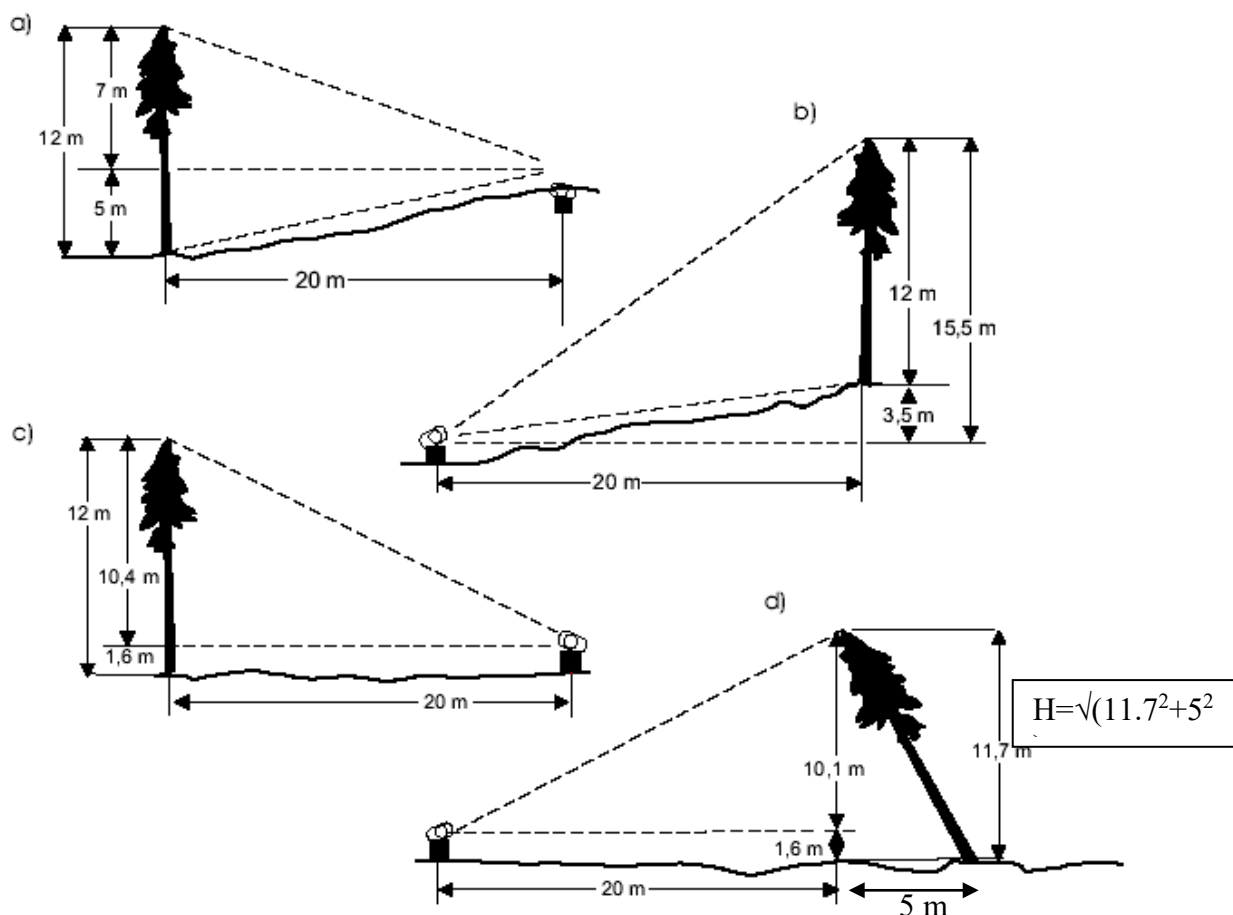
Note: You may find out the height of a tree (12 m for a, b, and c, and 12.7 m for d):
- By adding the readings of the tree top and the tree base, if they are on both sides of the horizontal line.: cases a) and c)
- By subtracting the reading of the tree base from the reading of the tree top, if they are both of them above the horizontal line: case b)
- For a inclined tree (case d), once calculated the height h between the tree top and the ground, just below the vertical projection of the tree top, then measure the distance D from the tree base the point located just at the vertical of the tree top, and calculate the tree height H by applying the formula: H= √(h²+D²)

Measurement with a Blume-Leiss dendrometer

This dendrometer is mainly composed of:

- A dioptric viewer providing two shifted images.
- Four height scales and one angle scale (the height scales correspond to a tree distance to measure at 15, 20, 30, and 40 m).
- An oscillating pendulum placed in front of the scales. The pendulum may be stopped as required with the help of a trigger or button to read the measure. A more recent model has two oscillating pendulums that may be stopped by means of two different triggers.

The instrument includes a rod with landmarks corresponding to different height scales. In order to carry out the measurements, the operator proceeds as follows:

On terrain with no or slight slope:

1. Choose the scale at 15, 20, and 30 or 40 m, the scale should approximate as much as possible to the estimated height of the stem.

2. Place the rod: the rod is fixed on the tree in order for the scale mark chosen is in front of him/her.

3. Distance positioning from the tree: with the help of a dioptric viewer, the operator looks at the landmark placed on the rod, in correspondence with the scale selected. If the distance from the tree is not correct, the operator will notice two shifted images. In order to achieve a correct positioning the operator will, either go forwards or go backwards, in order to see on his viewer two images aligned on the same line.

Figure 30. **Distance from the tree - Rod use**
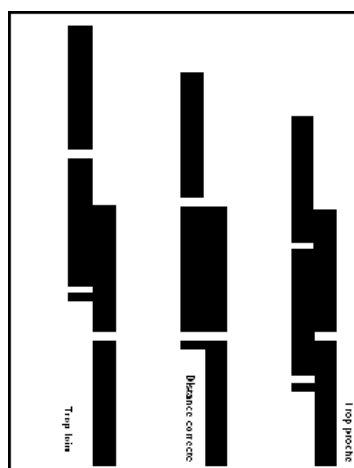
Note: the first figure (on the right), shows that the operator is too distant; the second one shows that the distance is correct; and the third one shows that the operator is too close.

4. **Observation angles**: in order to measure the height of a tree, the operator tries two observation angles. The first one at the top level and a second one at the base of the tree.

5. **Determining the height**: after each sighting, the operator reads the measure indicated on the scale which corresponds to the landmark chosen in the rod, and then he adds the results of the two measurements. The result of this addition corresponds to the height of the tree.

6. For the new model, the operator will read the measurements after the second sighting because each pendulum allows determining a separate measurement.

On inclined terrain:

1. The operator carries out the same operations indicated above, with the exception of the height calculation. If the operator is standing uphill, the results of the two measurements are added. If the operator is standing downhill, the sighting will be directed to the base of the tree and the result will be subtracted from the one directed at the top of the tree.

2. Then, a slope coefficient must be applied to the height result.

3. Carry out the observation of a tree point located at the same height where your eye is positioned in relation to the ground).

4. Check the angle's measurement in the appropriate scale.

5. Then check the table located on one side of the instrument, on top of which you will find a coefficient table that helps in making the necessary corrections.

6. Apply such coefficient following the formula below:

$$h' = h - hk$$

in which   h' = is the real height   h = measured height   k = coefficient correction

Height measurement with a Suunto

1. **Distance:** in order to carry out this measurement, a rod is fixed to the tree in a vertical position and at operator's eye height. The Suunto must be held firmly in vertical position.

2. **Height determination:** target the tree top, read the height measurement result, target the tree base, add or subtract, according to the case. If the distance between the tree and the operator is 30 or 40 m, it is convenient to repeat the measurements carried out, on a 15 or 20 m scale.

3. **Slope measurement and height correction**: measure the slope by targeting the point corresponding to the same height your eye is positioned in. If the Suunto does not include a scale in degrees or in percentage, make a conversion (printed text in the back, or calculator), then, multiply the height you obtained by the angle cosine.

Estimating tree height

In case the estimation is simply done by direct observation, it is necessary to calibrate from the beginning of the inventory, and when the stand type changes.

6.3 Use of receivers for Global Positioning Systems (GPS)

6.3.1 What is a GPS?

GPS is a satellite-based radio navigation system where the GPS receiver determines its geographical X, Y and Z position by measuring its distance to different satellites. There are 24 operational GPS satellites circulating around the globe in different orbits and they all transmit their spatial position. By deciding the timing to different satellites, which corresponds to the distance, the geographical position is obtained. The error in the estimation of the field positions lies within of a few meters depending on the quality of the receiver.

6.3.2 When to use it?

The field teams use GPS receivers in field:

- to navigate to the plot and reach the starting point for every plot;
- to verify the position of the plot after 125 meters (halfway) and after 250 meters (the end of the plot);
- to get the coordinate of the reference points (marker position and while accessing to the sampling unit). With the recorded field positions of the plots their actual extension can be applied in a GIS (Geographic Information System) to make overlays with other geographical data as satellite images, air photo, maps, etc., for further analyses.

The control teams are also using GPS receivers to locate the start positions of the field plots. Since the GPS position can differ with some meters, the control teams are also equipped with metal detectors to find the metal bar (permanent marker) that is put at the start position by the field teams.

6.3.3 GPS Guide

The guide, including functions and buttons depends on GPS model.

6.3.4 Use of GPS in the inventory (for each sampling unit)

- **Preparation:**

1. Initialise the GPS (first use only).
2. Set up units. Appropriate coordinate system and datum should be selected.

3. Enter the starting point coordinates of the plots into the GPS receiver as waypoints. The point name will be given in the following way: (three digits SU number) + "P" (=Plot) + (Plot number) + "S" (= Starting), e.g. for SU 13, plot 3: 013P3S. This can be done either manually, one waypoint by one, or automatically for a bunch of waypoints, connecting the GPS handset with a computer and using appropriate software.

- **In the field**

1. Read the coordinates and Mark the position of the starting position of where the field team starts accessing the SU by foot (i.e. at the closest road accessible by motor vehicle). The point name will be given in the following way: (three digits SU number) + "V" (=Vehicle) , e.g. for SU 13: 013V.

2. Identify the closed plot starting point (find nearest).

3. Navigate to the starting point of the first plot to be inventoried (Go To function). Use the compass / navigation page).

4. Read and Mark the position of the reference point during access to the SU. The point name will be given in the following way: (three digits SU number) + "R" (=Reference) + « reference point ID number (from 1 to total number of reference points" , e.g. for SU 13, second reference point: 013R2.

5. Read and Mark the position of the marker. The point name will be given in the following way: (three digits SU number) + "P" (=Plot) + (Plot number) + "M" (=Marker), e.g. for SU 13, plot 2: 013P2M.

6. Read and Mark the position of the middle and end of the plot. The point name will be given in the following way: (three digits SU number) + "P" (=Plot) + (Plot number) + "H" (=half) or "E" (= End), e.g. for SU 13, plot 2: 013P2H or 013P2E.

7. Navigate to the next plot starting point (Go To).

6.4 Horizontal distance measurements

All reference distances, such as plots and subplot dimensions, tree coordinates, are horizontal distances. When the terrain is flat, these distances can be measured directly. Nevertheless, in steep terrain, horizontal distances differ from distances covered, measured in the field (see Figure). A correction factor must be applied in order to find out the distance to cover in the field, in order to reach a given point. **Slope corrections will be made for all slopes above or equal to 15 percent**.

Figure 31. Slope correction
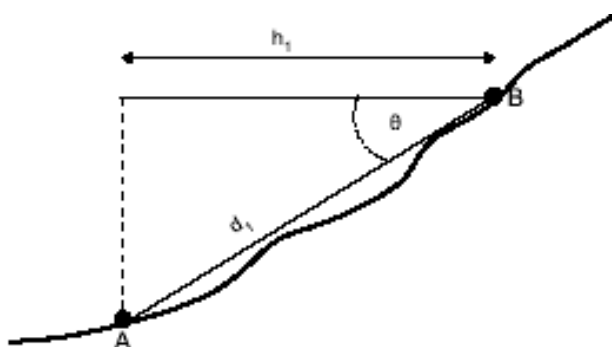
Note: The distance between two points, measured along one <u>slope</u> (d_1) is always longer than an equivalent <u>horizontal distance</u> (h_1). On slope terrain, the horizontal distance must be multiplied by a <u>slope correction factor</u> ƒs that corresponds to the inclination, in order to obtain a corrected distance. Θ is the angle between the horizontal and the distance d_1 along the slope A-B. Then $d_1 = h_1/cosine(Θ) = h_1 * f$ with $fs = 1/cosine(Θ)$

The following procedure is applied to calculate corrected distances:

1. Measure the slope angle of landmark *A* in direction of point *B* with the help of a clinometer (or

other slope measuring device); it is important to make sure that the measurement is taken along a parallel observation line to the average slope of the ground. The instrument must be located at the same height level of the target.

2. When the slope angle has been determined, find out the corrected distance d1 which corresponds to the desired horizontal distance, by using the slope correction table (see Table).

3. Go to point B, and measure the slope again, in direction of point A. If the result is different from the first measurement, repeat the operation.

When the operator cannot see the position of the next point or when the slope is not constant, one or several intermediate measurements become necessary. The horizontal distance is corrected by segments.

Table 14: Slope correction table

Slope		Factor	Horizontal distance (m)														Slope
%	°	f$_s$	5	10	15	20	25	30	40	50	120	125	130	240	245	250	%
15	9	1.0112	5.1	10.1	15.2	20.2	25.3	30.3	40.4	50.6	121.3	126.4	131.5	242.7	247.7	252.8	15
20	11	1.0198	5.1	10.2	15.3	20.4	25.5	30.6	40.8	51.0	122.4	127.5	132.6	244.8	249.9	255.0	20
25	14	1.0308	5.2	10.3	15.5	20.6	25.8	30.9	41.2	51.5	123.7	128.8	134.0	247.4	252.5	257.7	25
30	17	1.0440	5.2	10.4	15.7	20.9	26.1	31.3	41.8	52.2	125.3	130.5	135.7	250.6	255.8	261.0	30
35	19	1.0595	5.3	10.6	15.9	21.2	26.5	31.8	42.4	53.0	127.1	132.4	137.7	254.3	259.6	264.9	35
40	22	1.0770	5.4	10.8	16.2	21.5	26.9	32.3	43.1	53.9	129.2	134.6	140.0	258.5	263.9	269.3	40
45	24	1.0966	5.5	11.0	16.4	21.9	27.4	32.9	43.9	54.8	131.6	137.1	142.6	263.2	268.7	274.1	45
50	27	1.1180	5.6	11.2	16.8	22.4	28.0	33.5	44.7	55.9	134.2	139.8	145.3	268.3	273.9	279.5	50
60	31	1.1662	5.8	11.7	17.5	23.3	29.2	35.0	46.6	58.3	139.9	145.8	151.6	279.9	285.7	291.5	60
70	35	1.2207	6.1	12.2	18.3	24.4	30.5	36.6	48.8	61.0	146.5	152.6	158.7	293.0	299.1	305.2	70
80	39	1.2806	6.4	12.8	19.2	25.6	32.0	38.4	51.2	64.0	153.7	160.1	166.5	307.3	313.8	320.2	80
90	42	1.3454	6.7	13.5	20.2	26.9	33.6	40.4	53.8	67.3	161.4	168.2	174.9	322.9	329.6	336.3	90
100	45	1.4142	7.1	14.1	21.2	28.3	35.4	42.4	56.6	70.7	169.7	176.8	183.8	339.4	346.5	353.6	100
110	48	1.4866	7.4	14.9	22.3	29.7	37.2	44.6	59.5	74.3	178.4	185.8	193.3	356.8	364.2	371.7	110
120	50	1.5620	7.8	15.6	23.4	31.2	39.1	46.9	62.5	78.1	187.4	195.3	203.1	374.9	382.7	390.5	120
130	52	1.6401	8.2	16.4	24.6	32.8	41.0	49.2	65.6	82.0	196.8	205.0	213.2	393.6	401.8	410.0	130
140	54	1.7205	8.6	17.2	25.8	34.4	43.0	51.6	68.8	86.0	206.5	215.1	223.7	412.9	421.5	430.1	140
150	56	1.8028	9.0	18.0	27.0	36.1	45.1	54.1	72.1	90.1	216.3	225.3	234.4	432.7	441.7	450.7	150

Note: The table provides corrected distances for some horizontal distances, in function of the slope. For instance, the distance correction for a horizontal distance of 20 meters, with a slope of 30% is 20.9 m.

*For other horizontal distances, not included in the table, it is possible to get a corrected distance by multiplying the horizontal distance by the slope correction factor fs. For instance, on a terrain with a 25% slope, the aim is to find the horizontal distance of 7.5 meter, it is necessary to carry out the following operation: 7.5 * 1.0308 = 7.73 meters.*

6.5 Rapid Visual Soil Assessment technique

The methodology is designed to provide a cheap repeatable quick and immediate means of land degradation monitoring and assessment (McGarry and Sharp, 2001). It identifies the constraints to agricultural production; particularly water and nutrients in any land use type and applies robust "key" indicators for the constraints. Is a simple low cost monitoring system for capturing conditions and trend, extent and ramifications of soil degradation and organic matter decline in the cropping grazing and wood lands.

This method has a simple presentation but scientifically acceptable assessment as compared to the conventional sets of soil physical measurements commonly used, e.g. bulk density, disc permeameters, etc. VS-Fast focuses on qualitative and quantitative aspects of soil physical conditions (soil structure units and porosity) as well as soil colour, root development, slaking and dispersion, organic matter status and organic infiltration.

- **Soil surface condition**

This are important set of visible surface "clues" observed and recorded as one walks into a site. The indicators includes both negative and positive such as clods/rough soil surface, soil dispersion (white sand grains) on soil surfaces, water ponding on surface or in wheel tracks, hard setting surface or crust, poor crop growth in patches or strips, earth worm castes or burrows, standing (living) cover crops/plants.

- **Soil depth**

Using a measuring tape ruler or stick graduated in centimetres assess and measure the location of any visible soil layers in terms of colour, soil structure, root density, etc.

- **Soil texture**

Soil texture refers to the relative proportions of sand, silt and clay size particles in a sample of soil. Soil texture has important effects on soil water holding capacity, aeration and porosity conductivity compaction potential and resistance to root penetration, nutrient holding capacity and resistance to acidification.

Clay: Clay is less than 0.002 mm in diameter. Clay particles are extremely small, and can be seen only through an electron microscope. Dry, it forms very firm blocks, strongly homogeneous. Clay feels sticky and resists to pressure when wet. It easily forms into a ball and a quite thin ribbon at least 5 cm long. It is very plastic and sticky when very humid (feels like modelling clay). When a sample contains more than 40% clay, it is very difficult to moisten it. Water drains very slowly through clay soil. Therefore, clay soil remains saturated after a heavy rain. When this happens, there is little air in the soil, and plant roots cannot find oxygen.

Silt: Silt is 0.002-0.05 mm in diameter. Silt particles can be seen only through a microscope. When it is dry, it feels dusty, like flour. It is smooth and slightly sticky (like talc), and sometimes almost soapy, when wet. It does not resist to pressure and is therefore difficult to mould: it forms into a ball that easily breaks apart; if you squeeze it between your thumb and fingers, it will not form ribbons.

Sand: Sand is the largest size rock particle in soil (0.05-2 mm) in diameter. Sand particles can be seen without a microscope. Coarse sand particle feels gritty. A wet sand can not form a ball that holds together. When mixed with other materials (clay or silt), it appears when the wet sample was crushed for a while between fingers. In case of very dry samples, small hard fragments of clay, difficult to moisten, may likely looks like sand, and the same applies to a large quantity of fine gravel (sand size stops at 2 mm). Sandy soils have lots of air spaces between particles, so water drains quickly through these soils. They do not hold water and nutrients very well.

Loam: Loam is a mixture of sand, silt, and clay particles. Usually loam is easy to dig, and is neither too dry nor too wet during the growing season.

The texture is determined by estimating the proportion of the sand, silt and clay size particles. It can be done by taking one or two table spoonfuls of soil in one hand and adding water drop by drop to the soil as it is being worked in the hand until a sticky consistence is reached. The soil is

then rolled into a ball and ribbon and texture determined. This test is meaningful only if the soil is well moistened.

The figure represents the different texture classes and the corresponding proportion of sand, silt and clay.

Figure 32. Texture triangle
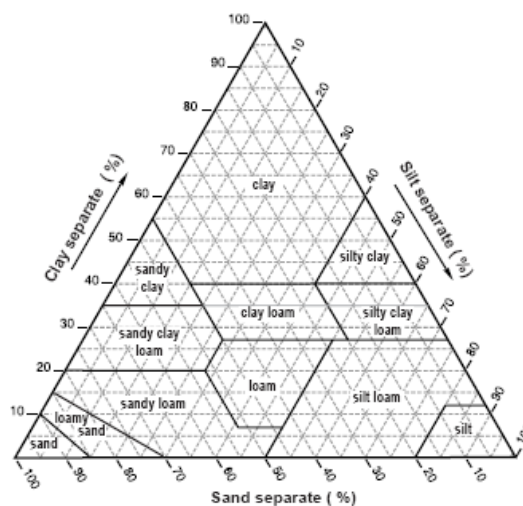
Source: USDA

- **Soil colour**

This provides many important soil properties of the soil e.g. the source material, climatic and human factors (i.e. soil water and organic matter status of the soil) that have altered the original rocks and sediments to give the current soil condition.

Generally, bright colours, and reds and oranges in particular, show good soil aeration and drainage (the iron in the soil is in the ferrous state). Dull and grey colours shows reduce aeration and a tendency for low-oxygen status and waterlogging. The darker the soil is the greater organic matter content. Also the darker the soil is the greater the organic matter content.

To measure the soil colour:

Take a lump of soil from the layer/ horizon to be described. Break the lump to expose a fresh face.

If the soil is dry, moisten the face by adding water drop by drop

Wait for the water to seep into the soil

Name the soil colour, e.g. red, brown, grey, black, white, etc.

If available, match the soil with a chip on the Munsell Soil Colour Chart. Record the Soil as: Hue/Value/Chroma value and name the colour

- **Soil pH**

It measures the molar activity (concentration) of hydrogen ions in the soil solution. At pH values less than 7 the soil is acidic whereas at pH values greater than 7 the soil is alkaline.

Take a small amount of soil from the centre of a layer of interest. Crumb it up and place onto a white tile or a piece of flat plastic. Add the universal indicator (the black purple liquid) and then mix the soil and the indicator. Add enough of the liquid to thoroughly moisten the soil without flooding.

Allow the mixture to settle for about two minutes and the using the "puffer" bottle gently puff a fine layer of barium sulphate powder over the mix. A colour will develop in the powder. Match this colour with the closest match on the test kit colour chart.

- **Soil drainage**

This is an important visible surface clue commonly observed and recorded as one walks at the site. Observation and record of the incidences of waterlogging on the soil surface are recorded.

One either observes incidences of waterlogging on the soil surface and/or observes the soil (mottles orange, grey, etc.) colour mainly from the soil block obtained during soil structural test.

- **Estimating proportion of coarse fragments and mottles**

Figure 33. Chart for estimating proportion of coarse fragments and mottles
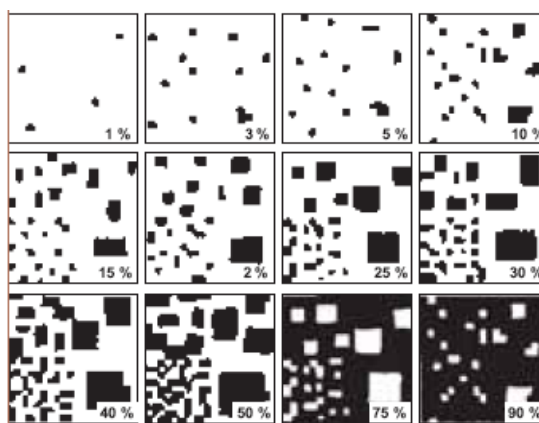
6.6 Instructions for using a random numbers table

Determine how many digits you need your random number to be, based on the total number of households. For instance, if you have 123 households you will need three digits, if you have 9 households, you need two digits.

With your eyes closed, use a pointed object, such as a pen or pencil, to touch the random numbers table. Your starting point is the digit closest to the point where you touched the table.

Reading to the right, read the number of digits required. Numbers that are not within the range needed (more than the total number of households) are discarded. Continue reading the numbers in the chosen direction until a random number within the range has been selected.

6.7 Interviewing and group-discussions techniques

6.7.1 Advice and recommendations

Interviewing is very important for the data collection, and it is not easy. Good interview techniques are achieved through experience, training and by following certain procedures. There is specific advice and tools developed suggesting how to approach people. The following section tries to advice as well as to foresee difficult situations.

- **Preparations:**

  o **Background information** through literature review and secondary data increases knowledge of the area and people, and is important for interviewing.

  o **Plan** which variables you need to know from the different key informants and focus groups, etc.

  o Go over the topics and sub-topics and prepare '**helper questions**' to be explored.

  o Each team member, who interviews, carries out the interview/visual tool following **one's own line** of questioning and reasoning.

- **Building rapport:** A good working relationship with the local people is easier to establish when the interviewer is well prepared, shows respect, and also remembers that it is the fieldworkers who are there to learn from the resource users on how they are using and benefiting from their local resources.

- **Scheduling interviews:** Respect of people's time can be demonstrated by trying to make appointments with informants and select a time and location where the interview is less likely to be disturbed. It is also important to be aware of when it is right to end an interview. The so called unscheduled interviews are also important. They may take the form as informal dialogue with people that are met when walking in the field, buying drinks in the local shop, etc.

- **The number of** interviewers in each household must be as few (i.e. two persons) where possible to avoid giving the impression that the outsiders dominate the process.

- **Interpreter:** Although by far the best is to be able to interview in the original language, there might be occasions where the use of an interpreter is necessary. When using an interpreter it is important to use simple language, and ensure that there is a good mutual understanding about procedures and what information is needed to be obtained. It must be remember that the role of the interpreter is to interpret, not to interview. Asking the same question in different ways (a form for cross-checking) is a way to check that communication is working. Other hints suggested are: have the translator sit behind you, maintain eye-contact with the respondent, even though you do not understand what exactly is being said. Often it is important to take your time, making sure that you understand what was being said and what this means, and that the interpreter understands what you mean. Interviewing with translators is, of necessity even slower, more difficult and more sensitive process than if in original language.

- There are different opinions on **taking notes and filling out field forms or questionnaires in front of the respondents**. In semi-structured interviews many argue that one should never pull up an official-looking questionnaire form. And it is often recommended not to take notes until rapport has been built (ask permission) as people are often reluctant to talk freely if notes are taken. If you take notes explain clearly for what use they are, and after an interview sum up what you have written. Doing visual exercises, such as RRA1 is

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[1] [1] For this study, the participatory techniques are referred to as Rapid Rural Appraisal (RRA) as it involves field workers learning from local people according to the field workers' agenda (IUCN, 1998). RRA uses a variety of tools and techniques to gather information. All its tools are designed to promote the participation of local people in both the collection and the analysis of the information. The tools approach facilitates questioning from different angles. Some are particularly helpful in addressing spatial issues, some gather more temporal information, and others help local people to analyse their situation by ranking issues or problems (Freudenberger, K, 1995).

a way where the noting or drawing is shared by all. Pre-noting some of the variables and topics to ask about in a small notebook as one gets familiar with the procedure is good practice and recommended.

- **Rural women** are often busy, and are often shy with strangers, regardless of whether the stranger is a man or a woman. Fieldworkers should be sensitive to the constraints facing women when undertaking interviews. Preferably a woman should interview the women respecting the female space.

- **Avoid asking questions** that are beyond the knowledge or experience of informants. Avoid giving opinions or using questions that may adversely affect the answers given. To be polite, local people will often agree with the opinions of field workers, even if they do not really agree or know.

- **Modifications:** Be prepared to modify the question or how you ask for information as new issues emerge and old issues become less critical. Issues should be explored as they arise in the conversation.

- **Use open-ended questioning** style that seeks explanations and opinions rather that yes-or-no-answers. Ask, for example, "where do you collect fuelwood?" Rather than, "do you cut fuel wood from the government forest?"(IUCN, 1998). To relate it to the sample site, follow up with "Do you also collect in this part of the forest" (pointing on a map at the sample site).

- **Probing and the use of non-leading 'helper questions':** Probing is an art that is learned through careful practise and means delving into a subject. Often topics are not easily comprehended at first; thus several questions around a sub-topic might be useful to ensure understanding (both yours and the participants'). Use such non-leading helper questions as: "Who?" "What?" "Where?" "When?" "Why?" "How?" "How many?" "How often?" And so forth. What are the implications, aims, intent, significance, or explanations of something? Ask yourself frequently – are you on the right track? (Messerschmidt, 1995). But it is also important to bear in mind that we do not need more information than the objectives have set out.

- **Sampling unit and subplot specific:** It is important to always be clear about relating the question to the site or the stand. Geographic reference is possible. If people say that they collect fuelwood in the forest, but they are referring to the general forest or another part clearly outside the sample site, a follow up question can be: "Do you then also collect fuelwood in this [specific] area"? And at the same time show the area visually, describe it, etc.

- The persons being interviewed might feel a reason to **hide** information on some of their usual practices, or at least not talk openly about these issues, especially if he/she perceives the interviewer being a representative of organizations or authorities that are preoccupied with hunting endangered species, entering national parks for foraging fuelwood, etc. It is therefore crucial with an atmosphere of understanding between the interviewer and respondent. However, if they perceive you as already aware of these practices, you will be able to learn more about the extent of these practices than if they perceive you as unaware. One technique is just to assume that the practice exist and directly move to the question of the relative importance for their livelihood: "In the neighbouring village they explained us that they hunt almost every week, how often do

you need to go to feed your family?/or how often do you hunt?" This type of question shows that you understand the reality in which they live. Whether you can use such a direct approach depends on the rapport you have established and needs careful consideration of the "mood" of the situation. In other circumstances a much more indirect approach is needed. The subject can be approached from different angles such as, for example, a conversation about foods and hunting practices of children. Often also, you might observe small things made of NWFP's while present in the community that may provide good starting points for a discussion on sensitive issues. Make use of these observations (AIDEnvironment, 1999).

- It is recommended adding a last question to the interview schedule which is, **"Are there any questions that you would like to ask us?"** This allows the interviewer to get information that might have been missed, puts the respondent(s) more at ease since the interview is not totally one-sided, and also provides a cross-check as to whether the respondent and interviewer understood what each was getting at. If the question is out of the blue, there is a good chance that the respondent did not really understand what the interview was about and the interviewer is unlikely to have elicited an accurate picture of the respondent's behavior or attitudes (Molnar, 1989).

- **A common mistake in interview situations is to promise respondents** that they will achieve tangible profits from co-operation. Never promise anything that cannot come true. As a general rule, explain that the best effort you can make is to relay a true picture of the situation that you encounter during the study. The field teams' task is to let the outside world know about local uses and importance of forest or other natural resources, and at best the decision-makers will be better informed about the issues of land resources.

6.7.2   Tool: stakeholder identification and analysis (Venn diagram)

This exercise identifies and provided information about the different resource user groups that can be important to schedule and plan interview with.

1. Organize a meeting with the local people (those who live close to the sampling unit, women, men, and maybe some key informants as well), and explain to them the objectives of the interview. During this brainstorming session, the group may be encouraged to work with the help of a flipchart or a similar tool.

2. List the users or groups of people, institutions who have an interest in the forest. Ensure that external stakeholders (those not physically represented, such as logging or pharmaceutical companies) are mentioned. Can large groups of stakeholders be divided into smaller groups? Are there certain groups who depend more on forest than others, or groups that use the forest more frequently?

3. Rank the groups, organizations, institutions and individuals.

4. Draw the sampling site in the shape of a box (for example), at the centre of the paper sheet or flip chart. Explain that each stakeholder group should be represented as a circle. The size of the circle represents how big their interests to the forest are: if their interests are large, intermediate or small draw respectively a big, medium or small circle.

5. Arrange the stakeholders circles in or around the sampling site square, to show the link existing between them and the sampling site under analysis. Discuss the rights that

different stakeholders have on the products and what products and services they are interested in.

Figure 34. Example of Venn diagram
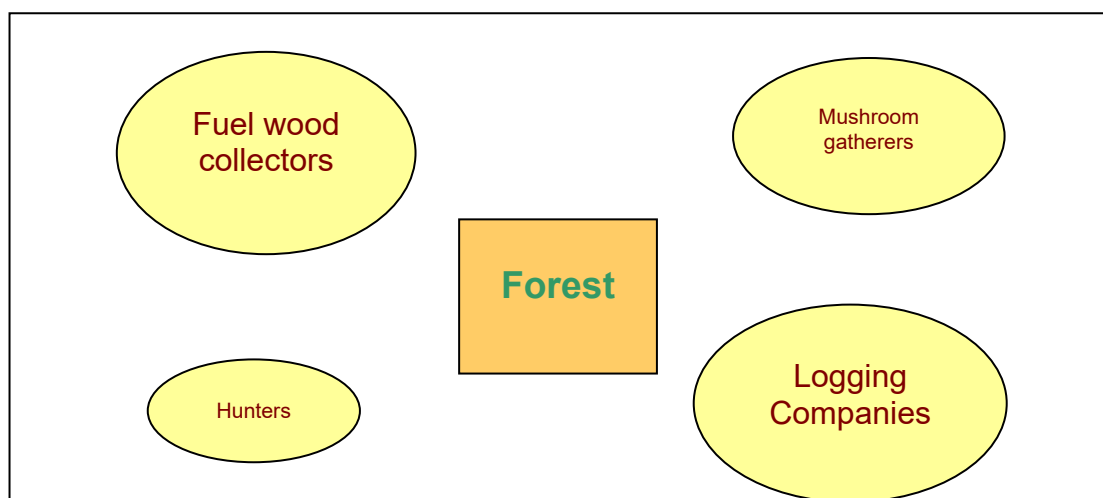
6.7.3 Tool: Participatory analysis of aerial photographs and maps

Looking at aerial photos and maps will stimulate discussion with both external key informants and focus groups, as well as acting as a good icebreaker (pocket stereoscopes, magnifiers etc.). Aerial photos are known to be especially useful for recording spatial information (IUCN, 1998).

When looking together at the aerial photos or maps it is natural to start to discuss aspects of access to the sample site, land use of the area of the sample site and the surroundings. If various aerial photos from different times (years, seasons) are available it is possible to explore the changes occurred. It is also a chance to obtain information on landmarks, location and names, administrative boundaries, forest products and in what seasons they are available. If possible try to mark the site on the photo with a transparency overlay. By noting on the photo, or sketching another map on another piece of paper one can record the information that comes out of the group discussion.

Contrary to sketched maps, **aerial photographs** represent a *true* image (however interpretation may be biased) of an area at a point in time. When adding local information to this it provides very important data. This information can also be relatively easy to transform to a conventional map or produce a sketch map based on the photo.

Topographic maps are indispensable whether or not aerial photographs are available in order to discuss and relate the sample site to a bigger geographic area.

Another exercise that opens for a lot of discussion and analysis is community mapping. In a community mapping exercise, the local people draw their community and surrounding. Often a facilitator might help to start off the work by drawing one reference point, a road, etc. But during the rest of the exercise, the people should draw their own map with as little interference as possible. During the drawing exercise, there is a lot of time for discussions on ownership, what is harvested in different parts, etc. A drawback, however, for this study, is that the sample site which is where we are collecting the data from, might not be physically close to the area where people live. In the context of the NFI it will be important to focus the mapping exercise as much as possible to the sample site (tract) and to the variables related to it. What is possible to do is to locate the sample site on the community map, if this is possible in the scale that is used.

6.7.4 Tool: Cross-checking and triangulation

This technique is important for interviewing. When doing any study, the researcher must be aware of bias. If a study is biased, it means that the results do not reflect the reality because one situation or perspective was favored. A study that fails to include the perspective of women may be gender biased. A study that fails to probe issues deeply may be subject to a bias of "politeness" if people tell only what they think the interviewer wants to hear. Triangulation also known as cross-checking is a way to ensure that the results of a study are as accurate and unbiased as possible.

Date and perceptions, for example may be explored using different methods, each exploration building a more comprehensive understanding of complex local realities. Similarly, by using a single method with several different groups (men, women, children, etc.), the different perspectives surrounding a particular issue can be revealed. Trustworthiness of data is strengthened through community verification of the findings (IIED, 1997).

Triangulation means looking at any problem or issue from as many perspectives as possible, but at least three (Freudenberger, 1995):

- Triangulation of the perspectives on the field team by having at least three people with different points of view (women/men, social scientist/technical specialist, insiders/outsiders, youth/elders, etc.).

- Triangulation of the perspectives of informants by ensuring that a wide range of people are interviewed and all information is verified by at least three different sources (women/men, old/young, diverse ethnic groups, etc.).

- Triangulation of information gathering methods by addressing the same issue using several different tools (historical interviews, spatial maps, seasonal calendars, etc.). Does the direct observation or mapping exercise coincide with what people inform later during the fieldwork?

It is necessary to keep good records on where information came from and whether the interviewer is confident on its accuracy. Cross-checking can be a time-consuming process and requires patience.

6.7.5 Tool: Direct Observation

Direct observation might seem obvious, but it is nevertheless very important. The field team must be attentive and observe the sample site and surroundings noting the general land-use, facilities such as shops, schools and markets as well as housing and infrastructure. Observing these traits may clarify discrepancies and information gaps that occur during data collection. Additional questions can be asked to address these information gaps. Often misunderstandings and contradicting information can occur if local people have not completely understood what was being asked. This usually happens because the questions were poorly phrased, too complex, or too general from the outset. The understanding of concepts may also be unclear across languages and culture.

Direct observation can increase the accuracy and reliability of information and also reduce the number of questions that need to be asked of local people. For example, there is no need to ask whether people use wood to build houses if all the houses that can be observed are built of wood.

6.7.6   Tool: Transect walk to the sample site

If the conditions and circumstances permit organizing such a walk, this is highly recommendable. A transect walk can be defined as a walk designed to follow a specific route, often across contour lines with different elevations and different ecological zones, etc. If a map is a bird's eye view of an area, a transect cuts across the same territory in order to get an idea of the diverse micro-ecological zones found in the landscape. In the context of the National Assessment, it is useful to go to the centre of the sample site (SU), or sometimes better, to a high point in the SU from which there is a good view. It is often possible to see boundary markers, different land use practices, etc. Both members of the field team as well as local forest users participate (and also key-informants if needed). Being able to discuss the forest and the forest products at the sample site with the forest users helps to tie the data-collection to the site.

Examples of directing questions:

• As the different land uses are crossed, questions should be asked to get a sense of what kind of tenure arrangements exist. "*Is the land owned? Borrowed? Subject of conflict? Is it farmed by women? Men? Outsiders?*"

• "*Are there some areas that are more in demand than others? How is this land allocated?*"

• "*What is the significance of any fences or boundaries that are observed? Are there more in some areas than another? Why?*" (Fences are often indicators that there is a competition for land or competing uses such as grazing and cultivation).

• "*What was the use of the land here ten years ago*?"

• "*Where we are standing now, what are the forest products that you/your family extract?*"

• "*That fruit we see over there- does anyone harvest that? Who? – Do you eat that? etc.*"

• Uses of various trees should be investigated. "*Who is allowed to use the trees and for what purpose? Are the rules the same for all tree species? Do they vary depending on where the tree is located?*"

• "*Is the group passing through any land that is borrowed?*" If so it is useful to begin to find out about borrowing practices.

• "*Is the group crossing through any communally owned areas?*" If so, it is an opportunity to begin to find out how they are managed.

One of the advantages of doing a transect is that often people are more willing to address sensitive issues such as land ownership patterns or conflicts, when they are away from the community. If a question is related to the things being observed, it can seem less intrusive than if the same question is asked in a more formal interview situation (Freudenberger, 1995).

In addition, a transect walk will give the field team a chance to show what they are doing, and also a chance to clarify queries after observations from the field measurements.

6.7.7   Tool: Identifying the products, services and their use

This exercise may be carried out with different focus groups to collect data on the products, services and their use for the different land use class in the plot. Gender issues should be considered and it may be more reliable to organize focus groups by groups of men and women separately, at least when discussing preference and importance of the products and services.

Steps and recommendations of the exercise are described below:

1. Make a list of the Land use/cover classes (if necessary). It is important to clarify with the users whether the different land use/cover means that they collect different products.

2. Ask which are the products and services used in the Land use/cover: *"Here, where we are standing* (if in the SU) *– or in this area on the aerial photograph/map* (point it), *what are the products that your family (/you/the village) extract?", "What is the local name?"* *"What do you use the product for?"*

3. Let the focus group brainstorm on the products they collect and note them down on a flipchart or paper. If you feel that some are left out, you might ask some indirect questions such as: *"Are there any medicinal healers here"* (if yes, does this mean that they must be extracting medicine plants, etc.), *"What do you usually cook with? Firewood, electricity or gas?"*

4. If different types of forest have been identified, *"Do different forest products belong to specific forest type?"*

5. Discuss about one product at a time, draw the product on the flipchart and systematically work on each one of them in order to gather all the necessary variables that are concerned with it.

6. If possible, an attempt must be done to find the species in the field.

6.7.8 Examples of how to phrase questions

A. Questions to key informants

- **Background information on the sampling unit (form F1, section A):**

Administrative divisions (7-10): *"What are the names of the administrative unit/ province/ district/ sublocation/ village and the local name of the area?"*

- **Information on the people living in the SU or in the surroundings (form F1, section B):**

- Population on SU (21): *"How many people live in this area?"* (The area refers to the SU).

- Year of settlement (22): *"How long (from what year) have people lived here?"*

- Population dynamics (23): *"Have most people in the area been living here for the past 5 years?"* or *"Have you seen a lot of changes during the last 5 years of people coming or going?"* If there have been changes *"Why?"*

- Main activity (24): *"How would you describe the livelihood of the majority of the people living in the area surrounding the SU?"* Cross-checking of direct observations and information provided by the interviewees may provide a good overview.

- **General information on the distance and access to the SU (form F1, section C):**

Distance to the permanent road, seasonal road, inhabited area, school, market, hospital (26-31): *"What is the distance from the SU to the closest permanent road, etc.?"*

- **General information on the land use/cover section (form F5, section A):**

- Designation/protection status (82): *"What is the legal designation of the forest? Is it a gazetted forest, a community [communal] Forest, a village forest, National Park, etc.?"*

- Ownership (83): *"Who is the legal owner of the land (forest) in the sample area? Is it*

public, is it private" If private *"Do people have land titles?"* But it is not recommended to ask directly questions about ownership, especially in areas where it is known that persons are mostly squatters.

- **Other variables**

Key informants may also have an opinion on variables asked to the focus groups, such as: most important resource products and services, ecological problems, rights and conflicts. One should keep in mind that in the absence of local people, the information will be provided mostly by the key informants. Moreover, even when the information is provided by the focus groups, it must be cross-checked with the data provided by the key informants and observations.

- Legislation and incentives awareness (101e and 101g): *"Are there any laws/ incentives concerning this product/service? If yes, which one?" "Are the local people aware of this legislation?"*
- Compliance (101f): *"Is the legislation concerning this product/activity respected?"*
- Application to forestry incentive (101h): *"Have the people applied for incentives concerning this product/service?*

Information that will help identifying important user groups. This information will help select individuals and focus groups to be interview.

B. Questions to focus groups and individuals

- **Land resources uses and products and services (form F6):**
- Products and services category (99): *"What products do you collect in this part of the land/forest?"*
- P/S Rank (99a)/ Species Rank (111a): *"Of all the products that have been identified, for your household/village/group, what is the most important product that is obtained/produced?"*
- Harvester / User (101): *"Who are the persons that harvest or use the product/ practise this activity?*
- Gender balance (101c)/Children (101d): *"Do the women harvest the product? Are the harvesters mainly women? "Do the children participate in harvesting the product?"*
- End-use (102): *"Do you sell this product?" if yes, "to whom?"*
- User rights (103): *"Who has the right to harvest/use this product/ to practice the activity?" "Is there anybody who may exclude the others from collecting it?" "If you can harvest it, is it because you are also the owner?" "Are the harvesting rights by tradition or are they legal?"*
- User conflicts (104): *"Related to the product that we have been discussing, do you feel that there exist any disagreements, either with other local people or with externals, about harvesting or using this product?"*
- Demand trend (105): *"Do you need more of this product?" or "Is the quantity you extract nowadays enough to satisfy your need?"*
- Last activity/extraction (108*): "When did you last collect this product?" "How often do you harvest this product/practise this activity?"*
- Trend (109*): "Did you (or your family) harvest as much of this product today as 5 years*

ago?"

- Change reason (110): if there has been any change in the quantity produced/ extracted/ frequency of activity, *"Why is it so?"*

• **Questions related to the SU (form F1, section C) may also be asked to the focused groups, when analysing the maps, especially:**

- Population dynamics (23): *"5 years ago, were there any people living here?"* or *"Do the young people often stay in the area when they have a family of their own or do they go to the city?"*

- Settlement history (25): *"What are the main historic events that you remember from this area, such as for example, conflicts, change of land tenure, natural disasters etc."*

• **Other questions related to the LUCS (form F5), which also may be asked or cross checked with observations or information provided by external key informant:**

- Environmental problems (84): *"What is the most important [ecological] problem in forest around in the area where you live? How does it affect the land? Have you seen any changes that are affecting your day to day life? Change in yield?"*

6.8 IUCN protected area management categories

Protected Areas – IUCN categories for nature protection	
I – Strict nature reserve / wilderness area	**Protected area managed mainly for science or wilderness protection**. These areas possess some outstanding ecosystems, features and/or species of flora and fauna of national scientific importance, or they are representative of particular natural areas. They often contain fragile ecosystems or life forms, areas of important biological or geological diversity, or areas of particular importance to the conservation of genetic resources. Public access is generally not permitted. Natural processes are allowed to take place in the absence of any direct human interference, tourism and recreation. Ecological processes may include natural acts that alter the ecological system or physiographic features, such as naturally occurring fires, natural succession, insect or disease outbreaks, storms, earthquakes and the like, but necessarily excluding man-induced disturbances.
II – National Park	**Protected area managed mainly for ecosystem protection and recreation.** National parks are relatively large areas, which contain representative samples of major natural regions, features or scenery, where plant and animal species, geomorphological sites, and habitats are of special scientific, educational and recreational interest. The area is managed and developed so as to sustain recreation and educational activities on a controlled basis. The area and visitors' use are managed at a level which maintains the area in a natural or semi-natural state.
III – Natural monument	**Protected area managed mainly for conservation of specific natural features.** This category normally contains one or more natural features of outstanding national interest being protected because of their uniqueness or rarity. Size is not of great importance. The areas should be managed to remain relatively free of human disturbance, although they may have recreational and touristic value.
IV – Habitat/species management area	**Protected area managed mainly for conservation through management intervention.** The areas covered may consist of nesting areas of colonial bird species, marshes or lakes, estuaries, forest or grassland habitats, or fish spawning or seagrass feeding beds for marine animals. The production of harvestable renewable resources may play a secondary role in the management of the area. The area may require habitat manipulation (mowing, sheep or cattle grazing, etc.).
V – Protected landscape/ seascape	**Protected areas managed mainly for landscape/seascape conservation and recreation.** The diversity of areas falling into this category is very large. They include those whose landscapes possess special aesthetic qualities which are a result of the interaction of man and land or water, traditional practices associated with agriculture, grazing and fishing being dominant; and those that are primarily natural areas, such as coastline, lake or river shores, hilly or mountainous terrains, managed intensively by man for recreation and tourism.
VI – Managed resource protection area	**Protected area managed for the sustainable use of natural ecosystems.** Normally covers extensive and relatively isolated and uninhabited areas having difficult access, or regions that are relatively sparsely populated but are under considerable pressure for colonization or greater utilization.

6.9 Field forms

Figure 35. Field form F1 Cover – Sampling Unit (cover page)

1. **NFMA Sudan**   **- F1 Cover-**

2. **SU N°** ....

SAMPLING UNIT (SU)...............

33d. Start date..../.../......33e. End date..../.../...... Leaving for............. 33f. ☐ .   33g.Base

Number of forms compiled (*in parenthesis, range number*)

PLOT 1			PLOT 2			PLOT 3			PLOT 4	
F2	(1)		**F2**	(1)		**F2**	(1)		**F2**	(1)	
F3a	(>=1)		**F3a**	(>=1)		**F3a**	(>=1)		**F3a**	(>=1)	
F3b	(>=1)		**F3b**	(>=1)		**F3b**	(>=1)		**F3b**	(>=1)	
F4a	(>=1)		**F4a**	(>=1)		**F4a**	(>=1)		**F4a**	(>=1)	
F4b	(>=1)		**F4b**	(>=1)		**F4b**	(>=1)		**F4b**	(>=1)	
F4c	(>=1)		**F4c**	(>=1)		**F4c**	(>=1)		**F4c**	(>=1)	
F4d	(>=1)		**F4d**	(>=1)		**F4d**	(>=1)		**F4d**	(>=1)	
F5	(>=1)		**F5**	(>=1)		**F5**	(>=1)		**F5**	(>=1)	

LUCC number

F6a	
F6a/b	

38. Description notes on the field work

Brief summary of the work carried out SU particularities, description of the difficulties encountered during data collection in the SU as well as strategy used, solutions for problems and recommendations

38c. **Organisation and site description** (team organisation and logistics, access, site description and particularities

38d. **Field measurements**(terrain, vegetation, measurements constraints and particularities)

38e. **Interviews & contacts with population** (contacts with interviewees, oweners, loca;l guide)

Figure 36 . Field form F1a- Sampling unit (reverse side)

Field form F1a- Sampling Unit (reverse side)

1. **NFMA Sudan**   - F1a/R -
2. SU N° ....   SU

A. Tract Location

7. State ....

8. Locality.................................

9. .Village..................................

10. ....

10b. ....

14c. Coordinates Tract SW corner

14b. Longitude _ _ , _ _ _ _ _ ° E   14d. UTM E _ _ _ _ _ _ _ m

14a. Latitude _ _ , _ _ _ _ _ ° N   14e. UTM N _ _ _ _ _ _ _ m

14c Coordinate system: UTM
(Projection) (datum: WGS84)

B. Human Population

21.Sedentary population distribution	Total	F	M
21c. Number of households*			
21f. Average household size*			
21. Population on the SU**			
21d. Adult literacy rate (%)**			
Number of refugees			

21e. Ethnic group   C

22. Years since settlement   C

23. Population dynamics   C

24a. Population main activity   C

24b. Secondary activity   C

	25. *Settlement history*	25a. *Year /Period*
0	Not Applicable (no inhabitants....)	
1	War/Civil conflict	
2	Insecurity, ethnic conflicts	
3	Change of ownership/land tenure	
4	Expansion of agriculture	
5	Urban development	
6	Infrastructure, electric power	
7	Economic crisis	
8	Natural disaster	
9	Human disease	
10	Rural-to-urban migration	
11	Urban-to-rural migration	
12	Rural-to-rural migration	
13	Urban-to-urban migration	
14	Immigration	
15	Emigration	
16	Squters	
Others		

* In 21c and 21f: F= Female headed / M= Male headed; ** In 21 and 21d: F= Female / M= Male.

C. Proximity to Infrastructure

Distance from centre of SU to nearest:

26. All-weather road _ _ , _ km   29b. Veterinary services..........km
27. Seasonal road _ _ , _— km   30. School................................km
28. Settlement _ _ , _—— - km   31a. Food Market place- _— km
29. Health centre ——, —— km   31b. Input Market place.........km

D. Access to SU

Starting position coordinates:
32a. UTM E _ _ _ _ _ _ m   32b. UTM N _ _ _ _ _ _ _ m
Access time:
33a. Start time: _ _ : _ _ h   33c. Start date***: _ / _ /_
34a. End time: _ _ : _ _ h   34c. End date***: _ / _ /_
34b. Arriving at plot No ☐   34c. Total Access Time: _ _ : _ h

Reference points of access path (Route sketch on reverse side)

35. ID	36. Description	37a. UTM E (m)	37b. UTM N (m)	36b. Photo #	36d. Bearing (°)

38a. *Notes*..

....

....

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Field form F1a- Sampling Unit (reverse side)

1. **NFMA Sudan**   **- F1a/R -**

2. **SU N°** ....   **SU**

Route sketch

38c.Notes ....
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Figure 37 . Field form F1b- Persons involved in the assessment

Field form F1b- SU- Persons involved in the assessment

1. NFMA Sudan   - F1b -

2. SU N°   PERSONS INVOLVED IN THE ASSESSMENT

P......./........

E. Team/Owner/Informant list

15. Name	16. Address	16b. Title / Function	17. Phone number	18a. Team leader	18b. Team member	19. Owner	20. Informant*						
							O	E	M	S	I	X

*Code indicates the informant's relation to the area, i.e. O = Estate Owner, E = Employee, M = Manager of site, S = Settler, I = Internal key informant; X = External key informant

Notes...

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Figure 38 . Field form F1d- Wildlife observations

Field form F1d- F. Wildlife Observations

1. NFMA Sudan   - F1d -

2. SU N° ....   **Fauna in SU**

	112a. Common name	113. Direct observations		114.Indirect observations	
		113a. Count	113b. Total	114a. Count	114b. Total
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
99	Others				

38a. Notes

Figure 39   . Field form F2- Plot

A. Plot access

Starting position:

34g. UTM E _ _ _ _ _ _ _ m

34h. UTM N _ _ _ _ _ _ _ m

Access Time:

34i. Start time: _ _ : _ _ h

34j. End time: _ _ : _ _ h

B. Time Record of Work within Plot

Day 1:

48. Date 1**: _ _ / _ _ / _ _

49a. Start time: _ _ : _ _ h

51a. End time: _ _ : _ _ h

** dd/mm/yy

D. Plot Plan (52)

Central line bearing:

Plot # 1 =   0°   Plot # 2 =   90°
Plot # 3 =   180°   Plot # 4 =   270°

Plot end point:

39e. UTM E _ _ _ _ _ _ _ m

39f. UTM N _ _ _ _ _ _ _ m

C. Plot Starting Point Description

Plot starting point (given):
39a. UTM E _ _ _ _ _ _ _ m

39b. UTM N_ _ _ _ _ _ _ m

43. Plot starting point plan:
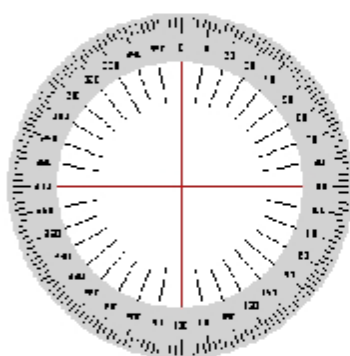
Plot middle point:

39c. UTM E   _ _ _ _ _ _ _ m

39d. UTM N   _ _ _ _ _ _ _ m

Reference points surrounding Marker position

44. ID	45. Description	46. Bearing* (°)	47. Distance* (m)	36c ID Photo

* From Marker position

53. *Notes*: _____
_____
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Figure 40 . Field form F3- Plot – Trees measurements

4a. LUCS N°	55. Tree /Stump N°	55b. Stump	56. Species name		57. Tree/ Stump location			58. Dbh[1]	59. Diameter height[2]	60. Year(s) since cut	61. Total height	62. Bole height	63. Stem quality	Health			
			56a. Common/local (language)	56b. Scientific name	57a. Along plot axis	57b. Left axis	57b. Right axis							64b. Crown Condition	64. Overall tree Condition	65a. Causative agents[3]	64c. Decomposition status [4]
					m	m	m	cm	m	C	m	m	C	C	C		C

[1] Or Dsh if stump height <1.3m   [2] To be indicated if different from breast height (1.3 m)   [3] Multiple choice   [4] Only for dead trees

68.Notes...

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Figure 40 . Field form F3b- Plot – Trees measurements

4a. LUCS N°	55. Tree /Stump N°	55b. Stump	56. Species name		57. Tree/Stump location			58. Dbh[1]	59. Diameter height[2]	60. Year(s) since cut	61. Total height	62. Bole height	63. Stem quality	Health					Branches[4]							
			56a. Common/local (language)	56b. Scientific name	57a. Along plot axis	57b. Left axis	57b. Right axis							64b. Crown Condition	64. Overall tree Condition	65a. Causative agents[3]	64c. Decomposition status [4]		B1		B2		B3		B4	
																			66a. D1	67a. L1	66b. D2	67b. L2	66c. D3	67c. L3	66d. D4	67d. L4
					m	m	m	cm	m	C	m	m	C	C	C	C	C		cm	m	cm	m	cm	m	cm	m

[1] Or Dsh if stump height <1.3m   [2] To be indicated if different from breast height (1.3 m)   [3] Multiple choice   [4] Only for dead trees   [5] For branches with minimum diameter ≥20cm and length ≥2m

68. *Notes:*...

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Figure 41 . Field form F4abcd- Measurement

A. Measurement points (MP) – Topography and soil (in all LUCS)

Measurement point N°1

4b. LUCS N°
Site: 71. Slope %
70. Slope orientation °
72. Relief C
72b. ID Photo
72c. Photo bearing °
Soil[1] 75. Organic layer thickness cm

74. Soil drainage ☐ C

Measurement point N°2

4b. LUCS N°
Site: 71. Slope %
70. Slope orientation
72. Relief C
72b. ID Photo
72c. Photo bearing °
75. Organic layer thickness s cm
74. Soil drainage ☐ C

Measurement point N°3

4b. LUCS N°
Site: 71. Slope %
70. Slope orientation
72. Relief C
72b. ID Photo
72c. Photo bearing °
75. Organic layer thickness cm
74. Soil drainage ☐ C

[1] Soil measurements don't need be carried out if no other measurement is undertaken at the Plot

B. Litter subplot (LSP)

LSP N° 1
41. LUCS N° ☐
801. Litter depth ☐ cm
802. Litter composition ☐ C

LSP N° 2
41. LUCS N° ☐
801. Litter depth ☐ cm
802. Litter composition ☐ C

LSP N° 3
41. LUCS N° ☐
801. Litter depth ☐ cm
802. Litter composition ☐ C

C. Land Use/Cover Area in SubPlots

Subplot N°1

Subplot	4c. LUCS N°	54c. SP Area %	4d. LUCS N°	54d SP Area %	4e. LUCS N°	54e. SP Area %
Rectangular						
Circular						

Subplot N°2

Subplot	4c. LUCS N°	54c. SP Area %	4d. LUCS N°	54d SP Area %	4e. LUCS N°	54e. SP Area %
Rectangular						
Circular						

Subplot N°3

Subplot	4c. LUCS N°	54c. SP Area %	4d. LUCS N°	54d SP Area %	4e. LUCS N°	54e. SP Area %
Rectangular						
Circular						

79b. *Notes*: (Measurement Points and LSP)

D. Circular Subplots – Small trees measurements (0 cm < dbh < 10 cm) (only in Forest, OWL and Woodlots LUCS)

77. *Species name*		CSP N°1			CSP N°2			CSP N°3		
77a. **Common/ local** (language)	77b. **Scientific name**	4g. LUCS N°	78a. Counts	78b. Total	4g. LUCS N°	78a. Counts	78b. Total	4g. LUCS N°	78a. Counts	78b. Total

79b. Notes (trees measurements in CSP)..
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....
....

E. Rectangular Subplots (RSP) – Shrubs/Bushes measurements (all LUCS)

6. RSP Nº	4h LUCS Nº	56. Species name		58b. Nº of stem/unit	58. Average stem D0.5	59. Diameter measurement ªheight ²	61. Average height
		56a. Common/local (language)	56b. Scientific name	m	c	cm	m

79a. *Note*s (Shrubs/Bushes):

· *if different from 0.5m*

F. Rectangular Subplots (RSP) - (Indicator Plant Species)*   (in all LUCS excluding water and crop lands)

300. Indicator species name		301a. Indicator *	301b. Quality	RSP Nº 1		RSP Nº 2		RSP Nº 3	
300a. Common local (language)	300b. Scientific name			40. LUCSN*	302. Abundance	40. LUCS N*	302. Abundance	40. LUCS N*	302. Abundance

* Soil measurements don't need be carried out of the other measurement to undertaken at the Plot   ᵃ Multiple choice

G. Fallen Deadwood Transect (FDT)

FDT Nº1			FDT Nº 2			FDT Nº 3		
4j. LUCS Nº	811. Diameter	812. Decomposit	4j. LUCS Nº	811. Diameter	812. Decomposit	4j. LUCS Nº	811. Diameter	812. Decomposition status
	cm	C		cm	C		cm	C

79d. Notes (fallen deadwood):

Figure 42 . Field form F5- Land use / Cover Section (LUCS)

A. General

80. Land use/cover class		C
81c. Accessibility		C
81a. Width ☐ m	81b. Length ☐ m	
82. Designation/Protection status		C
Land tenure		
83. Land Ownership		C
93a. Management agreement		C
Vegetation cover:		
92. Tree canopy cover		C
92g. TOF distribution		C
88. Trees expected		C
92a. Shrub cover		C
92b. Shrub height		m
92d. Herbaceous cover		C
92e. Plant Residue cover		C
92f. Crop Residue cover		C
Drainage:		
74b. Water logging	☐ C	
74c. Impeded/ filtering capacity	☐ C	

Environmental problems

	84. Category¹	84c. Severity	84d. Trend
		C	C
0	None identified		
1	Reduced water levels in rivers/wetlands...		
2	Dried up of water sources		
3	Rainfalls variability		
4	Drought		
5	Floods		
6	Poor water quality		
7	Air pollution		
8	Erosion		
9	Loss of soil fertility		
10	Reduced yields		
11	Dust storm		
12	Hail storm		
13	Uncontrolled burning		
14	Landslide		
15	Wind fall, wind blow		
16	Overexploiting resources		
17	Overgrazing		
18	Loss of habitats		
19	Reduced species diversity		
20	Animal / wildlife disease and mortality		
21	Plant pest		
22	Invasive species		
Other:			

84e. Soil erosion

0	No soil erosion
1	Gullies
2	Rills
3	Sheet
4	Pedestals
5	Root exposure
6	Sedimentation (behind
7	Sealing
8	Water ponding
9	Siltation
10	Abrasion
11	Rock outcrops
12	Dunes
Other	

*Multiple choice

Fire:

85. Evidence		C
86. Area		m²
87. Type		C
87b. Cause		C
87e. Frequency		C
87f. Trend	☐ C	
87g. Month----- ' ------mm-mm		
87h. Severity	☐ C	

Wildlife:

94c. Wildlife disturbances		C

Photos LUCS

701. Photo N°	702. Description	703a. UTM E (m)	703b. UTM N (m)	35d. Bearing (°)

B. Forest and other wooded land management structure

90. Stand origin*		
91. Stand structure		C
93. Management plan		C
83b. Forest ownership		C
94. Human disturbance		C
94b. Disturbance types		C

*N=Natural regeneration; P=Plantation; C=Coppice; nk= not known

95. Timber exploitation*

0	No felling
1	Clear cutting
2	Selective felling (single tree)
3	Group felling
4	Strip felling
Other	
Other	

95b. Stumps removal		Y/N
95c. Branches and tops removal		Y/N

96. Silviculture*

0	No practice
1	Pruning
2	Thinning
3	Coppicing
4	Pollarding
6	Enrichment planting -
7	Enrichment planting - exotic
8	Sanitary cutting
9	Controlled burning
Other	
Other	

97. Logging technology*

0	Not Applicable
1	Manual
2	Chainsaw
3	Mechanised (tractors
4	Animal
Other	
Other	

C. Grazing, soil and water conservation

144. Soil and water c

0	None
1	Leveling
2	Contour farming
3	Contour strips
4	Terracing
5	Crop residue incorporati
6	Cover crops / vegetation
7	Mulching
8	Windbreak
9	Grassed waterways /Ch
10	Tree planting/ Agrofore
90	Not known
Other	

Grazing:

138. Intensity	☐	C
139a. Overall quality	☐	C
139b. Quality trend	☐	C

98b. Notes (LUCS):

_____
_____
_____
_____
_____
_____
_____

*Multiple choice ** Code: 1=low, 2=Medium, 3=High
*** Not cultivated currently but in the past one year

Figure 43 . Field form F6a/b- Land use / Cover class- Products and Services

Land Use/Cover Class- Products and Services (recto/verso)

1. NFMA Sudan
2. SU N° .... 80. LUCC

LUCC- PRODUCTS & SERVICES

-F6a/b-

									Harvest														Legislation		Incentives	
99. Product category	99a. Product cat. importance	111. Local or scientific species / varieties name [language]	11a. Species ranking	11b. Part of the plant used	102. Commercial end-use	104. Conflicts	105. Demand trend	106. Supply trend**	107. Period	108. Frequency	109. Trend	110. Change reason	266a. Market price	266b. Market price unit	101. User group	101a. User group ranking	103. User rights	268. Sale to	101b. Organizational level	101c. Gender balance	101d. Child participation	101e. Awareness	101f. Compliance	101g. Awareness	101h. Application
C	C		C	C	C	C	C	C	M-M	C	C	C	SP/Unit		C	C	C	C	C	C	C				
														c											
														s											
														s											

B. Services provided by the land use class

148. Service category[1]		148b. Service importance	Legislation		Incentives	
			101e. Awareness	101f. Compliance	101g. Awareness	101h. Application
0	None identified					
1	Soil Protection					
2	Soil Fertility					
3	Water Conservation					
4	Water Purification					
5	Climate regulation					
6	Disease control					
7	Windbreak					
8	Shade					
9	Religious / Spiritual					
10	Cultural Heritage					
11	Recreation / Tourism					
12	Aesthetic					
13	Education / Scientific studies					
14	Employment					
Other:						

C. Biodiversity indicators

160. Insect pests, diseases and invasive species				
160a. Category	160b. Local or scientific name (varieties)		160c. Affects	160d. Severity
C			C	C

161. Threatened and extinct species		
161a. Category	161b. Local or scientific name (varieties)	161c. Status
C		E/T

162. Wildlife Abundance			
112. Local or scientific name	112a. Evidence	112b. Abundance	112c. Trend
	C	C	C

D. LAND USE/COVER CHANGE

80b. Conversion	C
80c. To land use	C

68. Notes

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....

		Land Use/Cover Class- Products and Services (recto/verso)		-F6p -
1. NFMA Sudan				
2. SU N° .... 80. LUCC		LUCC- PRODUCTS & SERVICES		

| 99. Product category | 99a. Product cat. importance | 111. Local or scientific species / varieties name [language] | 111a. Species ranking | 111b. Part of the plant used | 102. Commercial end-use | 104. Conflicts | 105. Demand trend | 106. Supply trend** | Harvest | | | | 266a. Market price | 266b. Market price unit | 101. User group | 101a. User group ranking | 103. User rights | 268. Sale to | 101b. Organizational level | 101c. Gender balance | 101d. Child participation | Legislation | | Incentives | |
									107. Period	108. Frequency	109. Trend	110. Change reason										101e. Awareness	101f. Compliance	101g. Awareness	101h. Application
C	C		C	C	C	C	C	C	M-M	C	C	C	SD/ Unit		C	C	C	C	C	C	C				
									·																
									·						c										
									·																
									·						¤				■						
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NATIONAL FOREST MONITORING

FOR REDD+ IN SUDAN

Manual for integrated field data collection

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